OCTOBER 20, 1958

Published every-other-Monday

Chemical Engineering

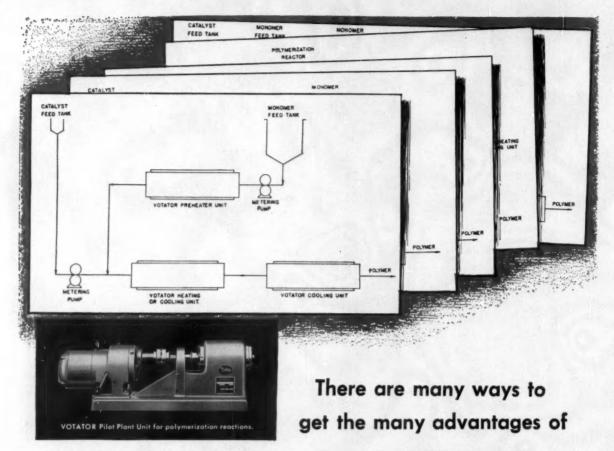


how computers can stimulate



creative engineering





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The above flow chart shows just one of the many systems which can be used for continuous polymerization reactions with VOTATOR\* Heat Transfer Equipment. These scraped-surface heaters, coolers and reactors are combined with other VOTATOR components to give you optimum results for your specific polymerization requirements.

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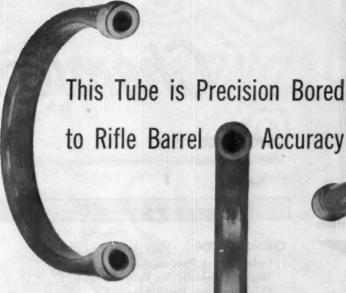
Pilot sized components

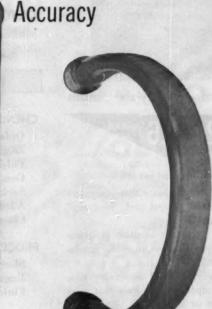
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Ashcroft Duragauge in Phenol case — a tough, rigid plastic turret type case for wall or flush mounting. The Bourdon tube in Ashcroft Duragauges is machined mirror-smooth inside and finish ground outside to exact tolerances. Strong, uniformly thick walls assure precise flexibility—sustained high accuracy and long life.

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Twenty-first of Twenty-six Issues

21/26

#### How computers stimulate creativity

There are at least three ways that computers can stimulate or even compel real "blue sky" creative engineering thinking.

- First—By their needs for accurate programming, they force you to think in really fundamental terms.
- ► Second—The way they cut computing time lets you explore important problems that were hitherto impossible or impractical.
- ► Third—Time that used to be spent with slide rule and calculator can now be used creatively in analysis and evaluation of a computer's answers. (p. 147)



#### New help for batch process metering

Are you missing a bet in your batch processes? It's easy to make a simple volumetric tank do your liquid measuring. Accuracy is as good as with meters or weigh tanks—often better. Inert atmospheres easily handled, too. (p. 150)



#### Final score on the June grads

Every one got jobs. All the engineering graduates, that is. The Engineers Joint Council finds that all 1958 grads were "able to complete their plans for post-graduate activities." This despite a large dose of springtime pessimism. (p. 171)



#### Tips on maintenance buying

It's possible to buy maintenance stores on an optimum order basis. Here's an engineering approach to the problem. It's a simple procedure that also lets you take advantage of quantity discounts. (p. 174)

# Chemical

OCTOBER 20, 1958

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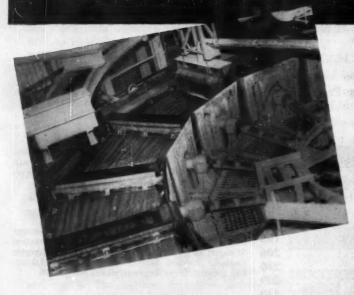
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Chemical Engineering

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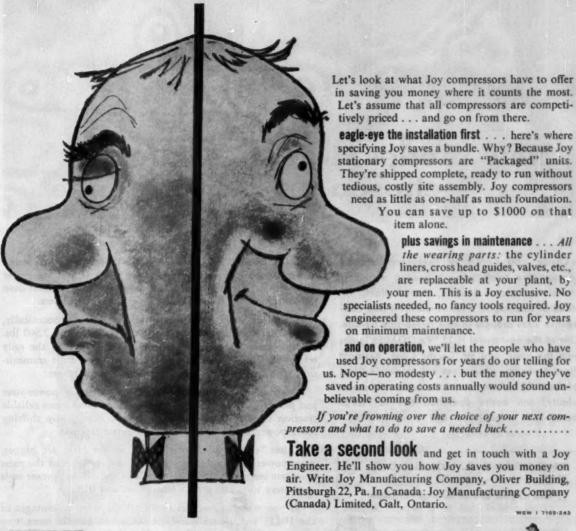
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We say that "PAYLOADER" tractor-shovels give you more performance for your money, and we mean it, but we prefer to let owners say it for us or let them prove it on their own job conditions as did Chase and Company Fertilizers.

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The inherent superiority of Roto-Louvre design also produces economies of installation and maintenance. The unit occupies up to 50% less space than other types of coolers. In addition, it is mounted parallel on its trunnions—won't become misaligned.

For a complete report on the cooling efficiencies of Roto-Louvre, contact your Link-Belt office.

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#### **Control Valves**

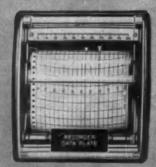
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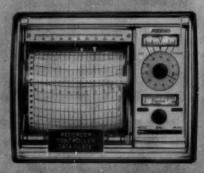


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actronic Consotrol Controller (shown 4/5 ac-te) concentrates all control and supervisory as in one slim 3 x 6 inch case. Controller on is entirely independent of recorder.







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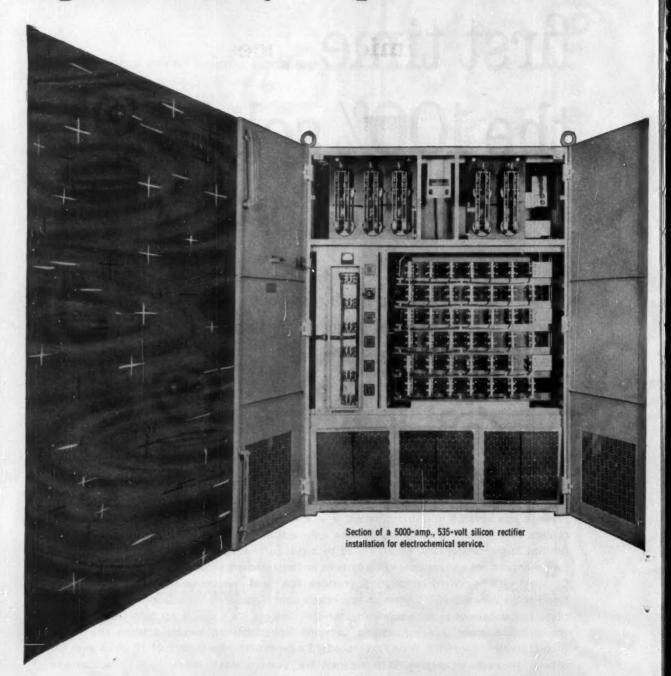
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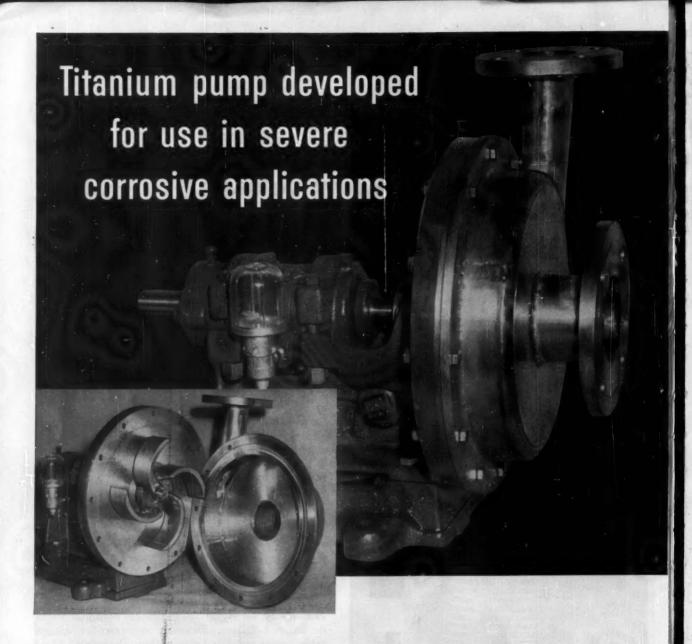
Ease of installation... units are completely factory-assembled. You need only make a-c and d-c connections.

No costly outages... indicating equipment will detect cell failure. Drawout construction makes replacement quick and easy without dropping load.

For full information on Westinghouse silicon rectifiers for electrochemical applications, call your Westinghouse representative or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania.

J-15008

YOU CAN BE SURE ... IF IT'S Westinghouse W



If corrosion is eating into your profits through material losses and costly downtime for maintenance, repairs, and replacement, then you will be interested in this new application of Republic Titanium.

It is a centrifugal pump designed and built by Mission Manufacturing Company, Houston, Texas. The finished pump, containing 34 pounds of Republic Titanium, is being used by a leading chemical company for handling ferric chloride at temperatures of about 212°F.

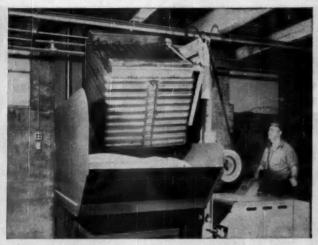
Generally, titanium is immune or highly resistant to oxidizing conditions. The metal offers outstanding resistance to pitting corrosion, a condition that is likely to occur when chlorides, such as ferric chloride, or other halogens are present in oxidizing solutions.

Performance ratings are essentially similar to those

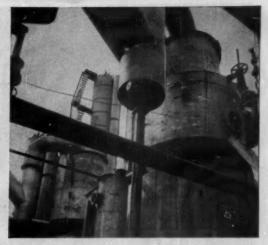
obtained for cast iron or corrosion-resistant alloys. Fewer pump sizes are required because the flat characteristics of Mission's impeller design provide a wide operating range and sustained efficiencies.

The pump was fabricated by shaping, welding in an inert gas atmosphere, and machining. Shielded-arc welding techniques now permit the use of titanium in its maximum corrosion-resistant form for particularly severe applications. The entire fabricating operation was performed without difficulty and with little change in procedures as compared to other materials.

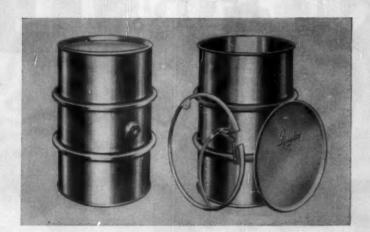
Does this use of Republic Titanium suggest an application for your processing equipment that needs to be corrosion-resistant, strong, lightweight? Republic Metallurgists will help you apply titanium's advantages now. No obligation. Just mail the coupon.



BULK CHEMICAL HANDLING CONTAINERS DEVELOPED BY REPUBLIC cut costs, save space, save man-hours, reduce loss, speed handling for The Climalene Company, Chicago, Illinois. A bulk-handling system worked out by Republic Materials Handling Engineers, and using Republic Roll-Over Boxes, permits one man to unload a complete car of chemicals in less than half the man-hours required of five men under the former system. By eliminating the use of bags, bag breakage and bag disposal problems have disappeared. Design and construction features of Roll-Over Boxes permit tiering to any practical height, save storage space. Contact your nearby Republic Materials Handling Representative for more facts on specially designed or standard handling units that can cut your costs. Or send coupon.



CORROSION PROTECTION AND SUBSTANTIAL SAVINGS in mainte nance costs are being realized by hundreds of processors using equipment fabricated from Republic ENDURO Stainless Steel. This versatile metal presents a smooth, hard surface that locks out contamination. It has no applied surface to crack, chip, flake, or peel away. ENDURO's high resistance to corrosion helps to keep critical processes pure. Safeguard the quality and purity of your product, and cut costs, by using equipment fabricated from Republic ENDURO Stainless Steel. Your equipment supplier has all the facts. Or send us the coupon.



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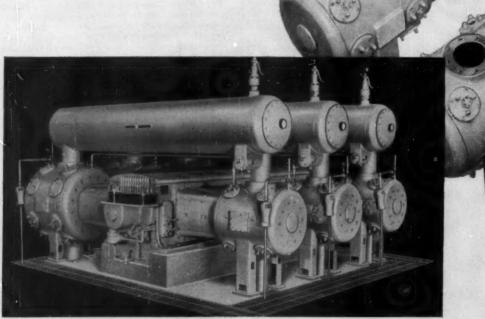
# BUILT FOR

or pressures to 15,000 ps3.a.

in sizes to 5,000 H.P.

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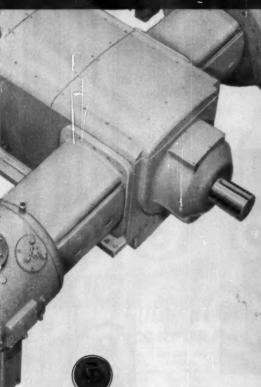
# CLASS FE

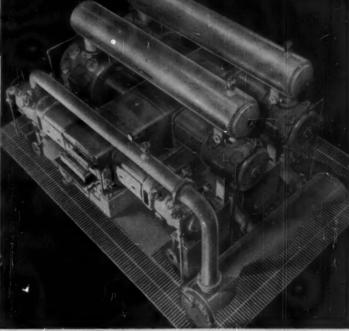


The six-cylinder compressor unit in the background photo above represents but one of numerous cylinder-crankthrow arrangements obtainable with the balanced-opposed Class FE. The unit shown directly above is a two-stage arrangement, 1000 H.P. size, one of two recently purchased by a large engine manufacturer.

**HEAVY-DUTY** 

# COMPRESSORS



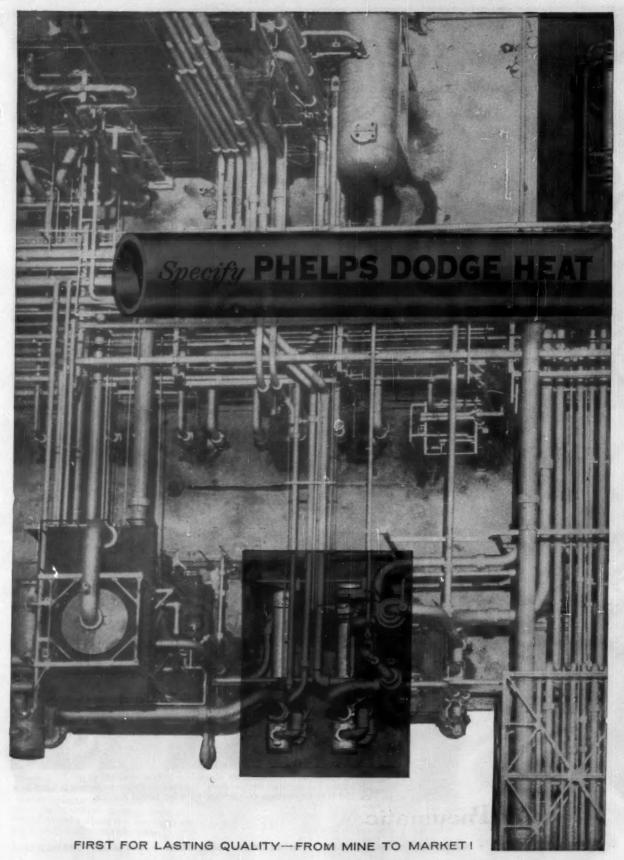


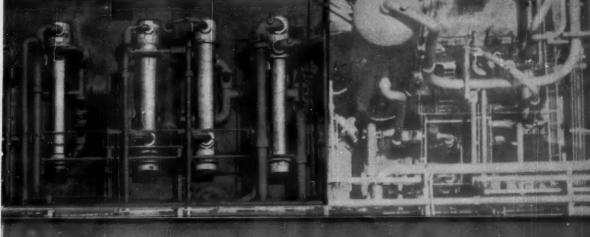
The high pressure compressor above is a further example of the flexibility of the balanced-opposed design. Here, the six-cylinder arrangement is used in a 1,250 H.P. three-stage compressor for wind tunnel service.

Chicago Pneumatic

AIR AND GAS COMPRESSORS . VACUUM PUMPS . PNEUMATIC TOOLS . ELECTRIC TOOLS . DIESEL ENGINES . ROCK DRILLS . HYDRAULIC TOOLS

CHEMICAL ENGINEERING-October 20, 1958





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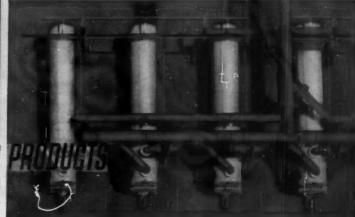
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#### CYANAMID

## **Chemical Newsfront**



NEW SURFACTANT IMPROVES EMULSION PAINTS. AEROSOL® TR surface active agent has a very high oil solubility and is particularly effective for oil-in-water emulsions. In emulsion polymerization, it offers an unusually wide working range of concentration from 0.05% to 1.0%, and produces small emulsion particles in a very narrow particle size range of 2 to 3 microns. At an optimum concentration of 0.1% to 0.5%, the emulsion formed is stable and of low viscosity. Aerosol TR produces high rub resistance and storage stability in paint formulation, and provides excellent water resistance in the dried film. (Industrial Chemicals Division)

NEW STEP IN MINIATURIZATION is Underwood Corporation's telephone-size, 7½-pound adding machine, with its two-piece housing molded of CYMAC SUPER® 201 methylstyrene-acrylonitrile copolymer plastic. This unusual thermoplastic was selected because of its toughness, surface hardness and resistance to heat, staining and denting. It is unaffected by the diester permanent lubricant applied to the mechanical assembly prior to encasement in the housing. The color, in two attractive tones, is molded in and will not crack, chip or wear off. (Plastics and Resins Division) \*\*Trademark\*\*

GRAIN GOING INTO STORAGE this year can now be protected against insects by Cyanamid's broad-spectrum insecticide, malathion, recently cleared by the United States Food and Drug Administration for direct application to grain after extensive research and almost two years of commercial use in Canada. Malathion has proved highly effective in providing continuous protection over long periods against major pests which infest storage bins. The small amount needed makes it economical to use and also presents no residue problems. Malathion can be applied directly to grain in both sprays and dusts, and used as clean-up sprays in and around both commercial elevators and farm storages.

(Agicultural Division)





ACTIVE PEOPLE can now find protection against objectionable perspiration odors developing in sports wear and other clothing made of cellulosic fabrics and blends. Perspiration has no offensive odor until after it undergoes decomposition by certain bacteria. Cyanamid's Cyana® purifying agent, applied to textiles at the mill, controls the growth of these bacteria on fabrics, keeping garments fresh. It maintains protection through many launderings, often for the life of the garment. (Organic Chemicals Division)

CH<sub>3</sub> NH CH<sub>3</sub>
N-C-N
CH<sub>3</sub> CH<sub>3</sub>

A NEW CYANAMID CHEMICAL, tetramethylguanidine (TMG), offers advantages as a catalyst for base-catalyzed reactions, as a chemical intermediate, and as a special solvent. A liquid with a slight ammoniacal odor, it boils at 159-160° C. TMG has a base strength comparable to sodamide and has the advantage of being soluble both in water and the common organic solvents. Since it is a liquid, it can be easily and accurately measured. Base-catalyzed reactions can therefore be run in a homogeneous medium. TMG can be used to catalyze cyanoethylation reactions and the reaction of phosphine with unsaturated compounds to yield complex organophosphine derivatives.

(Market Development Department)

#### CYANAMID

AMERICAN CYANAMID COMPANY 30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

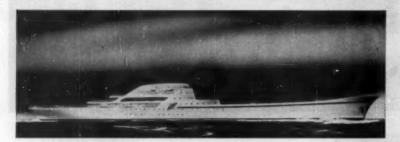
For further information on these and other chemicals, call, write or wire American Cyanamid Company
Chemical Engineering—October 20, 1958

# WATER JEVIS

#### from Cleaver Brooks

CAPSULE REPORTS AND INFORMATION ON THE PRODUCTION OF FRESH WATER FROM THE SEA

## Cleaver-Brooks Flash Evaporators to furnish fresh water for first nuclear merchant vessel



When the world's first nuclearpowered passenger-cargo ship, the Savannah, goes to sea, her fresh water will be supplied by Cleaver-Brooks Flash Evaporators.

Long operational runs without attention for feed water treatment or interruption for cold shocking plus minimum installed cost are the reasons behind the selection of Flash Evaporators. With the keel already laid, preparation for installing these Cleaver-Brooks evaporators moves ahead.

Widely recognized for having simplified the age-old scaling problem, the Cleaver-Brooks flash evaporators require less auxiliary equipment and less attention than any other type.

Cleaver-Brooks makes a complete line of flash evaporators for shipboard, seaboard and offshore rig use.

And for the Navy . . . Cleaver-Brooks will provide a 280,000-gallon-per-day fresh water plant for its first nuclear-powered aircraft carrier, now under construction at the Newport News Shipbuilding and Drydock Company.

It will be the largest distilling plant of any type ever installed on a sea-going vessel and the largest sea water plant in operation in the United States.

#### GIBRALTAR TO GET ADDITIONAL CLEAVER-BROOKS EVAPORATORS

Under contract with the British Admiralty, Cleaver-Brooks is installing a new 145,000 GPD flash evaporator plant with boilers which will be placed into operation early 1959. While the new Flash plant is for the NATO Base, Cleaver-Brooks is not a newcomer to the "Rock" as the City of Gibralter has been operating a vapor compression distilling plant since 1952.

Of particular interest in this plant are the design restrictions imposed by transportation and road facilities to the final site. With much of the fabrication arranged in England through subcontractors, final assembly must be completed at the ultimate location to stay within transportation weight limitations.

For helpful suggestions that solve your fresh water problems send details to: Dept. CE-108, Cleaver-Brooks Company, Special Products Division, 225 Grand Avenue, Waukesha, Wisconsin.



#### ECUADOR WATER PLANT EXPANSION

Continually plagued by lack of rain and high cost of importing fresh water, the coastal town of Salinas — several years ago — solved its problem of water shortage by installing 100,000 GPD capacity vapor compression sea water distillers. The tremendous local

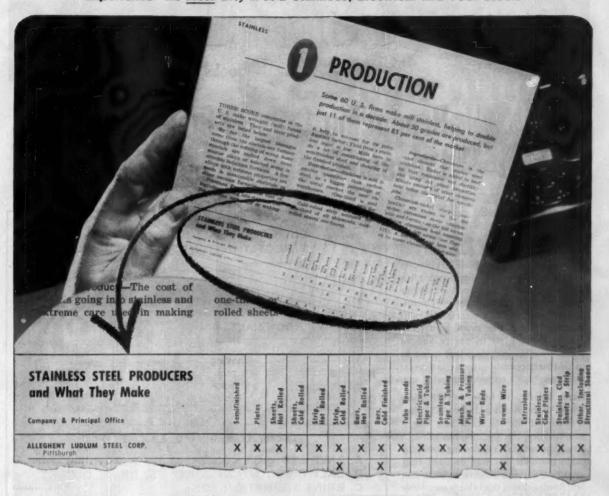
acceptance of distilled water as the potable municipal supply meant an increasing population and greater demand for water.

Now the outstanding vacation spot for Ecuadorians, Salinas is doubling the size of the water plant with the addition of the simple, low cost Cleaver-Brooks flash evaporators. The use of surplus natural gas (available from nearby oil wells) as primary fuel is expected to bring the cost of fresh water well below any previous experience in this area.

Many other coastal municipalities are now studying the situation to determine how their fresh water shortages can be similarly solved to aid population growth and municipal expansion.



BUILDERS OF EQUIPMENT FOR THE GENERATION AND UTILIZATION OF HEAT



#### Of the 60 producers of stainless steel...

#### only ALLEGHENY LUDLUM makes all sizes, shapes, finishes and analyses

In its November 4, 1957 issue, STEEL magazine published a complete run-down on the stainless steel industry. This article reveals that *only Allegheny Ludlum*, of the 60 some companies making stainless, produces all sizes, shapes, finishes and analyses.

This can save you considerable time and money. When you make Allegheny Ludlum your one source of stainless, you work with one sales engineer—one order, whether you buy sheet, strip, bars, tubing or whatever.

And, at the same time, you get the best technical service. A-L's crack research and development department is continually searching for new alloys, and better ways to use today's. Its findings are freely available to you through sales engineers, technicians and special literature.

Allegheny Ludium follows the product from the melt through to finished form, has greater quality control over the stainless you buy. And since A-L makes all forms of stainless, you get unbiased recommendations as to what is best for your individual needs.

Profit by Allegheny Ludlum's status as the only one-source integrated supplier of all stainless forms. Call your A-L representative today . . . see how he can save you money and time. Or write Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa.

#### **ALLEGHENY LUDLUM**

for warehouse delivery of Allegheny Stainless, call RYERSON

Export distribution: AIRCO INTERNATIONAL

EVERY FORM OF STAINLESS . . . . EVERY HELP IN USING IT



WEW 718

## Using Salt Efficiently

by INTERNATIONAL SALT COMPANY, INC.



# **Producing Crystal-Clear Brine at Lowest Cost—by Self-Filtration**

Today, more and more companies are using a foolproof brine-making process that produces crystal-clear brine from rock salt, without using supplemental filter beds or other filtering devices. This process takes place in the "Sterling Lixator," a rock-salt dissolver developed exclusively by International Salt Company. Operating on International's principle of self-filtration, the Lixator produces a rock-salt brine so high in purity and so brilliantly clean and clear that it can be used in many operations formerly thought to require highly refined evaporated salt.

Here, briefly, is how self-filtration works in the Sterling Lixator: A Lixator is filled with Sterling Rock Salt. Water, admitted near the top, dissolves salt as it flows downward. While flowing down, the brine made in this way becomes fully saturated, and can dissolve no more salt. Still flowing down, this brine is completely filtered by the salt-crystal bed in the bottom portion of the Lixator. Thus, the Lixate Brine drawn off through a discharge pipe at the bottom of the Lixator is clean, pure, crystal-clear—and the only source of power used is gravity, which costs nothing!

Other Lixator advantages. In addition to this superbly clean, fully saturated Lixate Brine, a number of other advantages are yours, when you use a Lixator:

- The Lixator permits salt storage and brine making at one location most convenient to the point of salt entry. Pipes deliver brine to points of use.
- Because Lixate Brine is piped to points of use, the work of moving dry salt from storage piles to other plant locations is eliminated. This can produce substantial savings in labor.
- The Lixator automatically controls salt feed, water feed, and brine discharge.
   Rapid, uniform brine production is maintained constantly, because in the Lixator there is no bridging, caking, or channeling.

BULK ROCK SALT SHIPMENTS UNLOADED
DIRECTLY INTO STORAGE TYPE LIXATOR

STERLING
ROCK SALT

STORAGE TYPE LIXATOR

A. SALT STORAGE ZONE
B. SALT DISSOLUTION ZONE
C. BRINE FILTRATION ZONE

BULK ROCK SALT SHIPMENTS UNLOADED

D. WATER INLET
E. BRINE OUTLET

The Storage Lixator — designed for larger operations. This is a combination salt storage tank and dissolving tank. On delivery, rock salt is unloaded directly into the Storage Lixator. The rest is automatic.

Many types of Lixators are available from International Salt Company. In addition to Storage Lixators, there are Silo Lixators and Sterling Model Lixators—in numerous designs to suit any plant layout. And every Lixator operates on the economical self-filtration principle.

For expert advice on the particular Lixator type that will do the best job for you, phone or write the nearest district sales office, or write to us direct. One of our sales engineers will gladly show you how this remarkable brine-making equipment can help you use salt most efficiently and economically.

Using salt efficiently in its many industrial applications calls for technical knowledge and experience. International Salt Company has both. Plus a continuing program of research and development in salt. These things can be put to work for you, in your plant, to help you get the most out of the salt or brine you use.

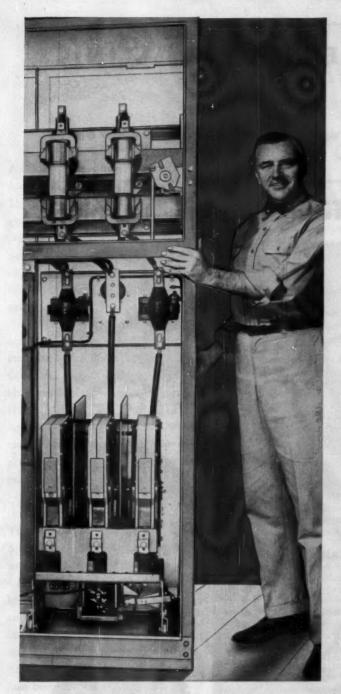
INTERNATIONAL SALT CO., SCRANTON, PA. Sales Offices: Atlanta, Ga.; Chicago, Ill.; New Orleans, La.; Baltimore, Md.; Boston, Mass.; Detroit, Mich.; St. Louis, Mo.; Newark, N. J.; Buffalo, N. Y.; New York, N. Y.; Cincinnati, O.; Cleveland, O.; Philadelphia, Pa.; Pittsburgh, Pa.; Memphis, Tenn.; and Richmond, Va.

Service and research are the extras in

STERLING SALT

PRODUCT OF INTERNATIONAL SALT COMPANY INC

会



# Tough high-voltage job?...Here's the answer!

Allen-Bradley High-Voltage Air Break Starters are ideal for frequent switching, reversing, plugging, or jogging.

A tremendous operating life has been built into these high-voltage air break starters... resulting from the use of the simple solenoid contactor. It's the same design—having only ONE moving part—that provides millions of trouble free operations in Allen-Bradley's low-voltage controls. These starters are made in a complete line for all types of service. Send for Publication 6080, today.



#### ONLY ONE MOVING PART With this simple solenoid design, all trouble causing piv-

sign, all trouble causing pivots, pins, and flexible jumpers are eliminated. Straight upand-down motion of contactor is virtually frictionless.



#### DOUBLE BREAK CONTACTS

Allen-Bradley silver alloy contacts never need maintenance...they remain in perfect operating condition until completely worn away. Vertical motion assures uniform contact pressures at all times.



#### FASTER ARC SUPPRESSION

The air break contactor employs a completely different blowout design and novel arc chute which assure rapid arc extinction. Chutes are molded from arc resistant material.



ALLEN-BRADLEY

MOTOR CONTROL

Allen-Bradley Co., 1337 S. First St., Milwaukee 4, Wis. • In Canada: Allen-Bradley Canada Ltd., Galt, Ontario

CHEMICAL ENGINEERING-October 20, 1958



#### CONDENSER TUBE CLINIC

Edited by ARTHUR W. TRACY, Metallurgical Engineer, The American Brass Company, Waterbury, Connecticut

#### Stresses and their Effects can be Minimized

STRESS-CORROSION CRACKING—The stress-corrosion cracking of copper alloys requires the simultaneous action of moisture, air, ammonia, and stress. Stresses may be residual or applied. All Anaconda condenser tubes are processed so as to minimize residual tensile stresses which may be formed during fabrication. Applied stresses from installing tubes in heat exchangers, nonuniform thermal expansion in tube bundles, or misalignment of condensers with other equipment occasionally cause stress-corrosion cracking.

Admiralty metal and aluminum brass tubes, although known to be susceptible to stress-corrosion cracking, seldom crack in condensers. Although ammonia is often present, either by chance or design, in vapors entering condensers, the amount of air (oxygen) is usually so small that the corrosive action of the ammonia is limited. It is obvious that noncondensable gases should be vented from condensers, not only to increase thermal efficiency, but to minimize corrosion.

ANACONDA Arsenical Admiralty-439 and ANACONDA Ambraloy-927 condenser tubes seldom stress-corrosion crack in normal service. Where operating conditions are severe enough to cause stress-corrosion cracking of these alloys, ANACONDA Cupro Nickel, 10%-755 and ANACONDA Cupro Nickel, 30%-702 tubes are recommended.

stress-relief annealing — Inasmuch as copper-alloy condenser tubes may stress-corrosion crack from stresses caused by cold-forming operations such as U-bending, the stresses should be removed by relief annealing the cold-formed portion of the tube.

FATIGUE CRACKING - Vibrations from moving parts of equipment or from pressure pulsations can induce stresses in condenser tubes high enough to exceed the endurance limit and cause a fatigue-crack failure. Vibration of a tube may even disturb water flow enough to cause impingement pitting at the point of greatest amplitude of vibration and the resulting pits can act as stress raisers. Pulsations can often be dampened by placing baffles or grids in the path of high-velocity vapors. Vibration of tubes can also be dampened by placing wooden slats between rows of tubes. Cupro Nickel, 30%-702 Tubes are more resistant to fatigue cracking than admiralty and aluminum brass.

TECHNICAL ASSISTANCE—Your tube problem may need special consideration. We are always ready to advise in the selection of the right alloy to give the best service. Write for the new edition of Publication B-2. The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 2019.



Intergranular stress-corrosion crack in 70/30 brass tube from oil refinery heat exchanger. Longitudinal section.



Transgranular stress-corrosion crack in admiralty metal tube from oil refinery heat exchanger. Longitudinal section.

#### ANACONDA

Tubes and Plates for Condensers and Heat Exchangers

NOMINAL COMPOSITIONS OF SOME ANACONDA CONDENSER TUBE ALLOYS

	Arsenical Admiralty-439	Ambraloy-927 (Aluminum Brass)	Cupro Nickel, 10%-755	Cupro Nickel, 30%-702
Copper, %	71	77	88.35	68.90
Nickel, %			10	30
Zinc, %	27.96	20.96		
Aluminum, %		2		
Tin, 96	1	44		
Arsenic, %	0.04	0.04		**
Manganese, %	**		0:40	0.60
Iron, %		******	1.25	0.50



Fatigue crack starting at pit in aluminum brass tube from power plant condenser. Longitudinal section.

# LAPP ALL-SERVICE ACID PROOF VALVES

SOLID CHEMICAL PORCELAIN
WITH LAPP TUFCLAD.

ARMOR

Nothing defies corrosion like chemically inert porcelain. As made by Lapp, it is pure, dense, hard, closegrained, homogeneous and non-porous. Therefore there can be no penetration—no crumbling from capillary pressures—no absorption of liquids to contaminate later processing.

Resistance to corrosion and contamination is but part of the Lapp story; there's a bonus in that Lapp Chemical Porcelain costs considerably less initially than most corrosion-resistant alloys and lined equipment. And since it almost never needs maintenance or replacement, the economy of your purchase is further increased.

Security (protection of plant and personnel) is assured by the Lapp TUFCLAD armor. It consists of multiple layers of fiberglass impregnated and bonded to the porcelain with an Epoxy resin. Fiberglass has high strength and chemical resistance providing protection against impact damage and external thermal shock. TUFCLAD armor holds line pressures even should porcelain become cracked or broken.

WRITE for description and specifications for the entire line of Lapp Acid Proof Valves. Lapp Insulator Co., Inc., Process Equipment Div., 2203 Chestnut Street, LeRoy, N. Y.



Lapp CHEMICAL PORCELAIN

Y-Valves as shown, and Angle Valves are available in Lapp TUFCLAD Chemical Porcelain in ½" to 6" sizes. Also safety valves, flush valves, plug cocks, pipe and fittings (to 8" dia.) and special shapes.



Drying an extremely heat-sensitive herbicide. If the dried product reaches 235°F. it decomposes and develops flammable gases. Another problem is that the stability of the dried herbicide decreases with any increase in moisture content. It is therefore necessary to keep the moisture content in the dried product very low (not more than 1% H<sub>2</sub>O). Due to excessive decomposition, previous drying methods were able to give only 60% yield.



"GENTLE-IZED" Spray Drying by NERCO-NIRO



An extensive series of tests to determine optimum operating conditions and special design details were carried out in the NERCO-NIRO Research Laboratories at Netcong, N. J. Later, 2,000,000 lbs. of herbicide were custom-dried for market research and preliminary commercial supplies.



Two years of trouble-free operation in our client's plant has proved the efficiency of NERCO-NIRO "Gentle-ized" Spray Drying.

2,000 lbs. of herbicide powder are produced per hour, at 99% yield, in a NERCO-NIRO Spray Dryer.



Herbicides, fungicides and fine chemicals that are difficult to handle can be processed for maximum yield, product quality and economy—the NERCO-NIRO way.

Consult our Spray Dryer Engineers
on your processing problems.

Nerco-Niro Spray Dryer Div'n.

**NICHOLS** 

Engineering & Research Corp.
70 Pine St., New York 5, N.Y.

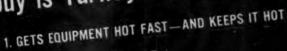
Branch Offices: SAN FRANCISCO . INDIANAPOLIS . MONTREAL



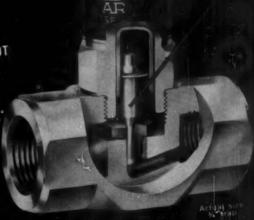
YARWAY IMPULSE\* is the only steam trap that continually samples fluid in the line to maintain condensate discharge close to steam temperature, eliminating condensate as soon as it forms.

Condensate seals the small control orifice against steam leakage under all normal operating conditions.

Here's why your best steam trap buy is Yarway Impulse-



- 2. ONLY ONE MOVING PART
- 3. LOW MAINTENANCE
- 4. SMALL SIZE—LIGHT WEIGHT
- 5. GOOD FOR ALL PRESSURES
- 6. NON-FREEZING
- 7. COMPLETE LINE FOR EVERY REQUIREMENT



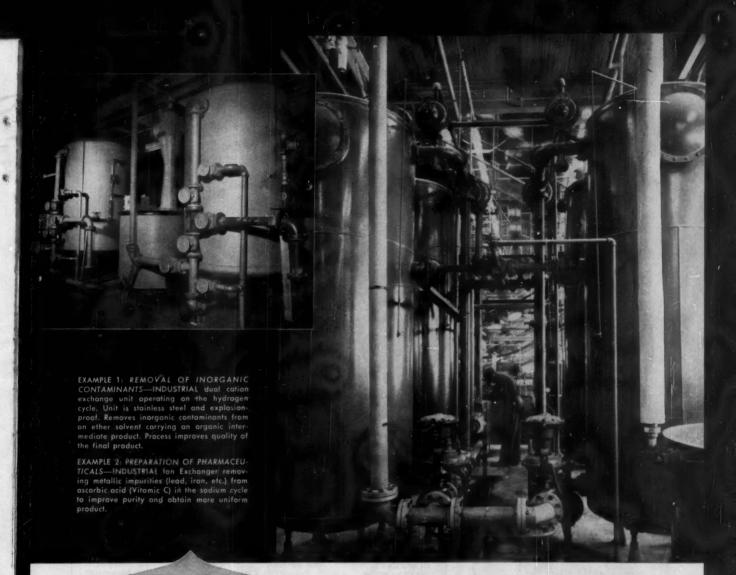
A COMPLETE LINE OF STEAM TRAPS, ALL OPERATING ON A PROVEN THERMODYNAMIC PRINCIPLE



impulse

Manufactured by YARNALL-WARING CO., 137 Mermaid Ave., Philadelphia, Pa. Stocked and sold by 270 Industrial Distributors Write for free bulletin "The Why and How of Steam Trapping"





#### INDUSTRIAL ION EXCHANGERS

## meet highest purity standards for continuous processes

Every day INDUSTRIAL Ion Exchangers are replacing expensive, complicated processing equipment in the purification of literally hundreds of chemical products. Why? Because INDUSTRIAL has successfully adapted the newest developments in ion exchange research to simple techniques. This new equipment provides advantages like these: NO HOLD-UP TIME...LOWER CAPITAL INVESTMENT...LOWER OPERATING COSTS...PLUS—PURITY STANDARDS TO MEET VIRTUALLY ALL REQUIREMENTS!

The operating simplicity of these new techniques permits immediate integration of an INDUSTRIAL Ion Exchanger in almost any continuous chemical process. The views on this page show some current specialized applications.

Investigate how INDUSTRIAL Ion Exchange equipment can solve your purifying problems at lower costs. Call or write today for details covering an analytical economics study.

INDUSTRIAL

C-258

INDUSTRIAL FILTER & PUMP MFG. CO. 5918 Ogden Avenue, Chicago 50, Illinois

PRESSURE FILTERS + ION & HEAT EXCHANGERS + WASTE-TREATING EQUIPMENT

Nash Instrument Air Compressors deliver only clean air, free from oil or dust, and without filters DISCHARGE PORT PORT HARGE

## Here is Why!

You can dispense with oil filters and dust filters when you install ®Nash® Clean Air Compressors. You can save the cost of maintaining these devices. You can greatly reduce instrument maintenance costs. For the Nash employs no internal lubrication, therefore no troublesome oil is in the delivered air. Moreover, air from a Nash is thoroughly washed and cooled as it passes thru the pump. Dust in the plant atmosphere, even fly ash, is immediately removed.

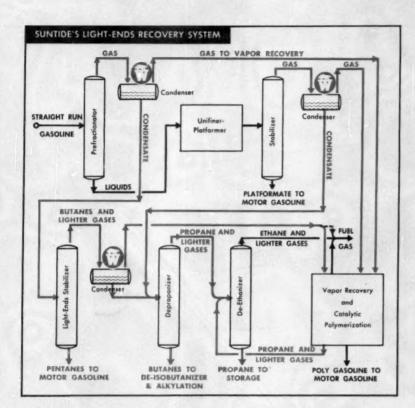
Nash® Clean Air Compressors are simple, with only one moving element. No valves, gears, pistons, sliding vanes, or other enemies of long life and constant performance complicate a Nash. No aftercoolers are needed. You will find it profitable to investigate these pumps, now. No oil filters. No dust filters. No internal lubrication to contaminate air handled. No internal wearing parts. No valves, pistons, or vanes. Non-pulsating pressure. Original performance constant over a long pump life. Low maintenance cost.

NASH ENGINEERING COMPANY
395 WILSON, SO. NORWALK, CONN.

# WOLVERINE

Items of Interest to the Processing Industry

PUBLISHED BY WOLVERINE TUBE



#### Payout in less than a year

#### SUNTIDE BOOSTS LIGHT ENDS RECOVERY

BY ERNEST DODD

Because of its ability to increase the throughput of existing heat exchangers and condensers, Wolverine Trufin® Type S/T-the integrally finned tube-was used to tube many exchangers in Sun-tide Refining Company's new light-ends-recovery system installed recently at Corpus Christi, Texas. Suntide is an affiliate of Sunray Mid-Continent Oil Co.

To reduce installation costs, Suntide designed its new light-ends-recovery system so that it would take full advantage of existing facilities and equipment. Because of the increased efficiency achieved in recovery of light ends, Suntide expects payout to occur in less than a year.

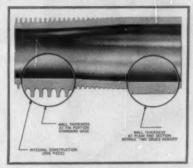
Installations such as this are made to order for Wolverine Trufin Type S/T. Since it is an extended surface tube, with fins extruded directly from the tube wall, Trufin Type S/T has approximately 21/2 times more surface area than plain tube. Because of this it is possible to pack more heat transfer surface into a given area—thus stepping up the capacity of existing equipment.

Also of major importance is the fact that Trufin Type S/T is interchangeable in shell and tube heat exchangers and condensers with the prime surface tube it was designed to replace. In fact only standard tools and retubing techniques are required.

Wolverine Trufin Type S/T is available in a wide range of sizes in copper and copper alloys, aluminum and steel. Next time you consider heat exchanger tube specify Wolverine Trufin Type S/T -realize the increased heat transfer performance this integrally finned tube makes possible. Write for complete information.

#### **WOLVERINE TRUFIN®** TYPE S/T IS ENGINEERED FOR THE JOB

Wolverine Trufin Type S/T is specifically engineered for use in shell and tube heat exchangers and condensers. The cutaway illustration, below, graphically shows its unique, one-piece construction. Because of this, Trufin Type S/T gives constant performance over a longer period of time. Fins are unaffected by vibration, thermal shock or pressure variations.



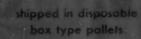
#### EASY TO INSTALL

Here's proof (in the drawings below) that Trufin Type S/T rolls into headers as easily as does plain tube. Standard rolling-in methods only are necessary there is no deviation from existing fabrication procedures.

Wolverine Trufin Type S/T is the original, integrally finned condenser tube. It was developed and pioneered by Wolverine Tube. Over the years Wolverine Tube has compiled a great deal of heat transfer information-particularly in the field of finned tube applications. If you have a problem - don't hesitate - ask for the assistance of a Wolverine Field Service Engineer. There is no obligation.



prefabricated to your specifications and shipped in exact installation order save space and reduce inventory problems eliminates one tube sheetcut rolling-in operations by half available in prime surface form or with integral fins provide easier transportation and handling-particularly in tubes over 30 feet in length make installations easier and faster



available in copper, copper alloys, aluminum, seamless steel

stock complete installations, use when needed

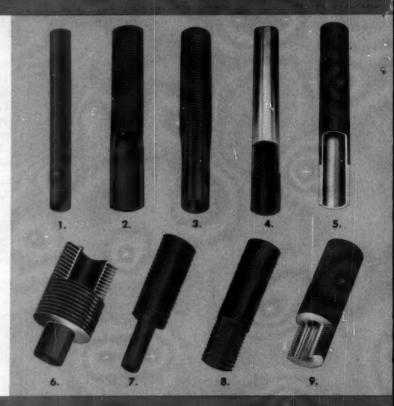
# WOLVERINE U-BENDS PROVIDE GREATER ECONOMY AND GREATER CONVENIENCE

You can save time and money by specifying prefabricated Wolverine U-bend condenser tubes in either finned (Wolverine Trufin) or prime surface form. Wolverine bends these tubes to your specifications—ships them to you in the exact order of installation in disposable box-type pallets. Check the advantages listed above and then the next time you retube specify Wolverine U-bend condenser tubes. Write for complete information or talk to your Wolverine Sales Representative.

# CONDENSER TUBES FOR EVERY JOB

From its years of experience in the heat transfer field Wolverine Tube has developed a condenser tube lineup designed to meet every need. Engineers can, for example, specify prime surface tube . . . integrally finned (Wolverine Trufin) or duplex tubing . . . all in a wide range of sizes and alloys. Next time you specify heat exchanger tubing remember that Wolverine Tube can meet ALL your needs.

- 1. PRIME SURFACE TUBE
- 2. WOLVERINE TRUFIN TYPE S/T
- 3. WOLVERINE TRUFIN TYPE W/H
- 4. PRIME SURFACE DUPLEX TUBE
- 5. WOLVERINE TRUFIN-DUPLEX
- 6. WOLVERINE TRUFIN TYPE L/C
- 7. WOLVERINE TRUFIN TYPE H/R
- 8. WOLVERINE TRUFIN TYPE H/A
- 9. WOLVERINE TRUFIN TYPE I/L



# TECHNICAL HELP FOR EVERY JOB















If you're having trouble with heat transfer problems . . . such things as equipment design or alloy selection you can obtain expert help real fast. Just get in touch with one of Wolverine Tube's Technical Sales Representatives. They're as close as your telephone and because of their specialized training are fully qualified to help you solve the most difficult problems. Call on them next time you need help.



#### WOLVERINE TUBE

CALUMET & HECLA, INC.

17232 Southfield Road

Allen Park, Michigan

PLANTS IN DETROIT, MICHIGAN AND DECATUR, ALABAMA SALES OFFICES IN PRINCIPAL CITIES EXPORT DEPT. 12 E. AITH STREET, NEW YORK 16, NEW YORK

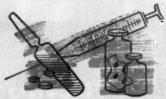
> Wolverine Trufin is available in Canada through the Unifin Tube Division, London, Ontario.



# How Can CO<sub>2</sub> Help You?

"CO<sub>2</sub> applications are unlimited"... a broad statement, but literally true. New ways in which this most versatile of all gases is improving products, cutting costs and saving time and labor are being developed almost daily. Some of the applications discussed here will be of direct, primary interest to you. Other uses, while perhaps not in your immediate specialty, may well be *adaptable* to your field. Check the box by each application on which you'd like detailed, technical data and mail this coupon.

Your inquiry will receive prompt, professional attention from the chemical applications staff of the world's largest producer of CO<sub>2</sub>.



Economical, Efficient "Freeze-Drying"—Freeze-drying is used to dehydrate heat sensitive substances at low temperatures. In the processing of blood plasma and the manufacture of penicillin, streptomycin and other pharmaceuticals, dry ice or liquid CO<sub>2</sub> is used to freeze the item being dried. Also, during the drying stage, dry ice is used to condense the moisture as it is sublimed under vacuum. Capable of quickly attaining and maintaining the extreme low temperatures required, CO<sub>2</sub> has the added advantage of requiring only a small capital outlay.

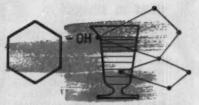


Precipitation of Carbonates —
Carbon dioxide in its gaseous form is used to

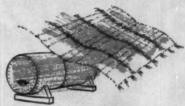
precipitate carbonates from water solutions. Ammonium bicarbonate and lead carbonate are examples. Bakeries and plastics manufacturers are among the many users of ammonium bicarbonate.



Simplifies Pulverizing of Materials With Low Melting Point—Many substances tend to melt or smear because of the heat generated in a milling process. DDT and vegetable fat flakes which are waxy and Teflon resin which is very tough and elastic are examples. In the low temperature pulverizing process the ingredient is mixed with crushed dry ice or low pressure carbon dioxide liquid is injected directly into the ingredient. These methods effectively inhibit the melting or smearing, prevents plugging and reduces horse power requirements. Gaseous carbon dioxide is also used to form an atmospheric "blanket" to effectively prevent fire during the grinding of flammable materials. An example of this application is the grinding of phosphorus pentasulphide and flammable resin materials.



Phenol — Phenol is a toxic, corrosive, flammable compound and is stored in an inert atmosphere under slight pressure to reduce vaporization, prevent oxidation and at the same time provide a non-flammable atmosphere. Carbon dioxide is also used as a pressure medium in transferring liquid phenol.



Effective Inerting Agent—There are many times when an inert atmosphere is needed to prevent fire or explosion. Before welding a tank that has been used for the storage of flammable liquid, CO<sub>2</sub> is used to inert the atmosphere in the tank so that welding can be done with no danger of explosion-CO<sub>2</sub>, acting as an effective atmospheric "blanket," also prevents oxidation and "skinning" of paints and oils.

# SEND IN THIS COUPON FOR

Check off the applications which interest you, fill in name and address, and mail the coupon to Liquid Carbonic for prompt information. You'll also receive a free copy of our Booklet, "Applications Unlimited", which covers dozens of other important uses of CO<sub>2</sub>.



Economical, Efficient "Freeze-Drying"  Precipitation of Car-	LIQUID CARBONIC  DIVISION OF GENERAL DYNAMICS CORPORATION  Dept. 914 • 135 South LaSalle Street • Chicago 3, Illinois
bonates  Simplifies Pulverizing of Materials With Low Melting Point	Name
Fireproof "Blanket"	TitleCompany
Effective Inerting Agent Other	Address
	CityState

# LOOK TO TOLEDO for Progress in the World of Weighing



# MULTI-SCAN FOR WEIGHING ITEMS IN MOTION

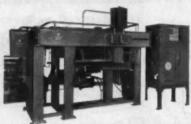
For items moving on overhead tracks (hog carcasses, for example) Toledo Multi-Scan system provides accurate average weights without necessity of bringing the swaying carcasses to rest. Weight data is fed into remotely located adding or other office machines for listing and totalizing of weights. Identifying data may also be introduced through key input



# AUTOMATIC BATCHING SYSTEMS



"Remocon" controls feature remote setting for fully automatic operation. Simple dial knob adjustments control quantities of each ingredient, allow precise duplication of batches. Extremely flexible — use with a single scale or multiple scale batching



#### PRODUCT TESTING AND CLASSIFYING

This custom-engineered Toledo automatically tests and classifies large coil springs. It is one of many types of Toledos used for classifying a wide range of items — from small packages to large cartons and production parts - in a variety of manufacturing operations.



# AUTOMATIC BULK WEIGHING

Toledos provide accurate, net weight listing and totals of bulk materials going into truck or carload shipments. Weighing is automatic. Toledo weight-control console with automatic recording and totalizing unit may be remotely located for operating convenience.





# Check These

# Specialized Jobs **TOLEDOS Are Doing**

When you have a problem in weighing, testing, counting, batching, sorting or weight data processing ... and you want the practical, economical answer . . . it will pay you to check with Toledo. Toledo's complete line of industrial scales provides today's effective answer for a wide range of needs; or for special applications, Toledo Scale engineers will work with you on modifications or completely custom-engineered units. Toledo's huge reservoir of experience is your assurance of a practical, cost-saving solution. Let us help you. Write TOLEDO SCALE, Division of Toledo Scale Corporation, Toledo 12, Ohio,

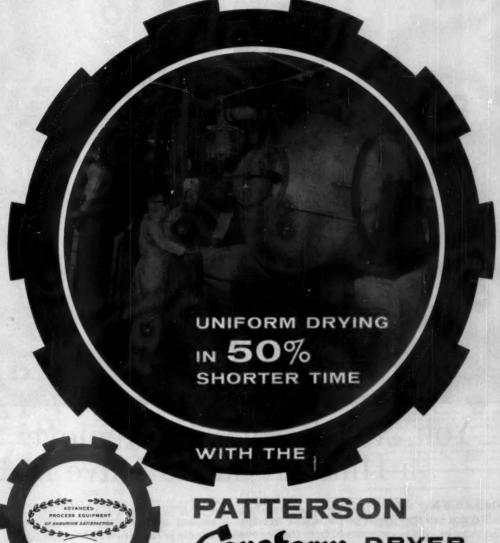
# TOLEDO HEADQUARTERS FOR

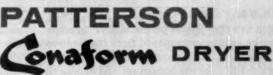
# **ELECTRONIC AND** HYDRONIC SCALES

Toledo Electronic Scale heads may be remotely located wherever convenient, because there are no me-chanical connections. Toledo offers full electronic scales, also combinations with hydraulic or mechanical components to meet a wide range of requirements. For specific applications, digital indication of parts counts may be provided electronically.



# FOR WYETH'S PENICILLIN AND OTHER ANTIBIOTICS -





Two Patterson Conaform Vacuum Dryers at Wyeth Laboratories meet highest standards of performance with strict product protection in drying penicillin and other valuable antibiotics. Replacing tray dryers, these modern units shorten drying time 50%, prevent variations in moisture content, permit less handling of product and protect against atmospheric contamination. The result is a uniformly dried, free-flowing product of dependable Wyeth quality—always. • Write for details on your projected drying application.

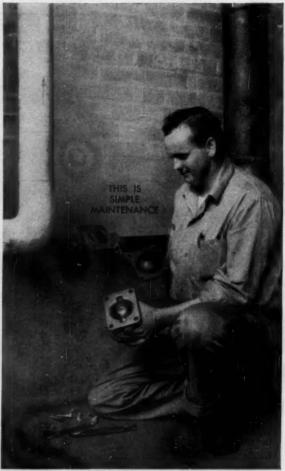
THE TUTTETSON FOUNDRY AND MACHINE COMPANY East Liverpool, Ohio



THE Patterson FOUNDRY AND MACHINE COMPANY (Canada) LIMITED

A Subsidiary of Ferro Corporation





# You NEVER have to remove a Hills-McCanna valve body!

When Hills-McCanna Diaphragm Valves are installed in a line they are as permanent as an elbow. The valve body is never removed from the line even for maintenance. Unions are not required. Ordinary tools are used to take the bonnet off and expose the diaphragm for quick replacement—a simple procedure that virtually provides a new valve for another period of long service!

Packless design of Hills-McCanna Diaphragm Valves assures good housekeeping, eliminates dripping, cleaning. There's no leakage, no seats to grind. But simplified maintenance is only part of the Hills-McCanna story—get all the facts on positive flow control, valve bodies to match construction materials of any pipe or pipe lining. Write for new booklet offer below.



NEW BOOKLET GIVES INSIDE STORY ON VALVE SELECTION...

This helpful guide discusses primary considerations in selecting valves, shows engineering principles and benefits of the Hills-McCanna Diaphragm Valve and applications. Write for your free copy today—"Diaphragm Valves for Every Type of Pipe."

HILLS-McCANNA COMPANY
4568 W. Touhy Avenue, Chicago 46, Illinois



# Emery

WEIGHING SYSTEM

BIN, TANK AND HOPPER EDITION

Covering design, development and application data on Emery Weighing Systems for industrial applications.

# ANNOUNCING THE NEW WAY-PAC\* LINE OF LOW-CAPACITY LOW-PRICE PACKAGED SYSTEMS FOR TANK WEIGHING

SIMPLICITY OF SELECTION AND OPERATION IS KEY FEATURE OF SUPPLEMENTARY LINE



FIG. 1 TYPE AC-1 CELL



FIG. 2 TYPE AC-1 "ROLLING-



FIG. 3 TYPE AD-1 CELL

The WAY-PAC, a new line of Emery low-capacity, low price packaged hydraulic tank weighing systems, designed specifically for the 0 to 1000 lb. range, is now being offered to the process industries.

The accuracy of the WAY-PAC cells is ¼ of 1% of

range. This extreme accuracy depends upon two significant design features . . . a moulded rubber diaphragm which maintains a constant acting area and a rolling ball assembly which performs the dual function of practically eliminating friction in the "piston-cylinder" assembly as well as preventing deleterious pinching of the diaphragm in the event of cross loading.

Five different cell types are available in the WAY-PAC line, each designed to perform with typical Emery excellence under different sets of operating conditions. (See Figs. 1 to 5).

The cells are manufactured of aluminum and a top grade bar stock steel to eliminate any possible leakage of the film of oil sealed in the diaphragm.

Unique design features, coupled with the ultimate in manufacturing craftsmanship, have produced in the WAY-PAC line equipment capable of long service life with extreme accuracy under the most rigorous conditions.

A complete line of related equipment is available including: tank pivots, strut assemblies, indicators and recorders. Although controlling and printing equip-ment can be supplied with and can be operated from the WAY-PAC cells, it is desirable that our engineers know the details of the installation in order to make a recommendation.



PIG. 4 TYPE AT-1



FIG. S TYPE AU-1

# Moulded Rubber Diaphragm Gives Constant Acting Area The moulded rubber diaphroam used in the WAY-PAC



in the WAY-PAC
cells possesses o
unique "rolling action" which imparts constant acting area to the
cell. This "rolling
action" is illustrated in Fig. 7.

Because of this constant "rolling action", the Emery WAY-PAC load cell is ex-tremely and consistently accurate.

# Exclusive "Rolling Ball" Head Available in WAY-PAC LINE



FIG. 6 CROSS SEC-TION OF "ROLLING-BALL" CELL. sive Emery "rolling ball" head

ve Emery "rolling ball" head.

In essence, the WAY-PAC "rolling all" head consists of three 1/4" diaeter stainless steel balls built into the top platen of the cell, riding top and the stainless of the cell, riding top and the stainless of the cell plates for the expansion and contraction of the expansion and contraction of the extracture being weighed, rides or a strickes steel balls and is transitted through them to the diaphragm.

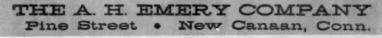
Load cells which do not take ex-ansion and contraction into consid-ration are not properly designed and annot compare with the WAY-PAC.

# NEW WAY-PAC **BULLETIN 582** AVAILABLE FOR DISTRIBUTION

Our new Bulletin 582 which describes in detail the Emery

WAY - PAC line and pro-vides an e as y-to-use method of figuring your system costs is now off Send for your copy right away.





# Kathabar systems kill micro-organisms and hold

# rooms at specific low bacteria and mold levels!



Because bacteria are killed by the chemical absorbent in a Kathabar system, it was long suspected that air passed through this system should be relatively free of bacteria. Proof of this theory would be of vital importance wherever airborne organisms contaminate humans or products.

To check this hunch, Surface asked a university research staff to conduct a series of exhaustive tests,

#### research proof

The conclusion of the research staff is that 97% of all micro-organisms (both pathogenic and non-pathogenic) are removed from air which passes through a standard Kathabar unit.

More tests are being continued in several industries with varying conditions. Current research results indicate that air purification—long desired by many industries and institutions—can be as feasible and simple as purification of drinking water.

#### what does it mean?

The system's advantages for hospitals show the significance of these findings. It provides the first continuous source of pure air. A Kathabar system will deliver to operating rooms air with not to exceed 5 organisms per 10 cubic feet (measured by the All-Glass Impinger method); provided the air supply contains 100 or less organisms per 10 cubic feet. This will maintain an operating room, with normal occupancy, at 10 organisms or less per 10 cubic feet—1/10 the normal level found by actual readings in hospitals.

The liquid sorbent is not affected by the organisms it kills. It is equally effective with any volume of air you require for your space or process.

The system also provides practical, year-round humidity control. It will humidify in the winter; dehumidify in the summer.

When possible it permits recirculation of air for operating, delivery, cystoscopic, and fracture rooms. Eliminating the need for all fresh air reduces both the first cost and operating cost of a Kathabar air conditioning system.

#### benefits for other industries

Hospitals, of course, are not alone in their need for continuous pure air. Direct and immediate benefits can be realized in other fields, too, such as foods, pharmaceuticals, beverages, clinics, laboratories, and public buildings.

Even where pure air is not a primary factor, it is an important added benefit. Examples are drying operations, storage, testing, comfort applications.

#### who uses Kathabar systems

Kathabar systems make profits out of air for these industries:

Atomic Energy Machining **Breweries** Matches Cake Mix Marine Candy Meat Cellophane Offices Cellulose Ordnance Cereals Paner Chemicals **Pharmaceuticals** Coffee Plastics Comfort Printing Compressors Rockets Cookies Rubber Electronics Shellac Explosives Sugar Film Sanitaryware **Foundries** Testing Gelatin Textiles Glass **Transformers** Glue Transistors Gum Vacuum Tubes Hospitals Varnish Hotels Waterworks Lacquer Wire Lenses Yeast

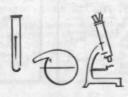
#### how they use Kathabar systems

Many of these industries are now discovering the benefits of air sterilization by Kathabar systems. Others use them to (1) maintain spaces at 80 F and 55% RH or lower; (2) obtain continuous air at sub-freezing dry bulbs and dew points; (3) eliminate condensation: and (4) improve drying processes.

#### send description of your problem

Air Conditioning and Drying Division SURFACE COMBUSTION CORPORATION 2380 Dorr Street Toledo 1, Ohio





Kathabar systems by



Now you can get the famous advantages of ROCKWOOD Ball Valves—IN STAINLESS STEEL—

the 316

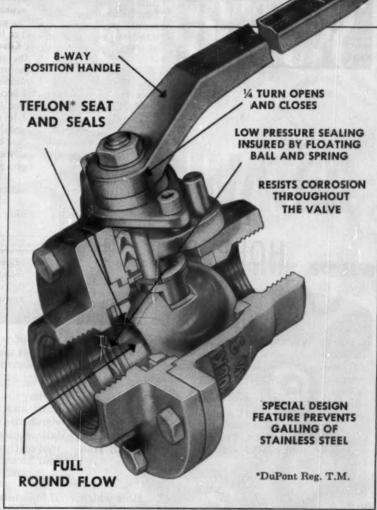
Rockwood's new "316" Ball Valve gives you positive sealing over a wide range of pressures. A simple design utilizing a Teflon ball seat and spring assures you of low pressure sealing (spring behind ball forces ball against the seat) and high pressure sealing (pressure supplements spring for pressure-tight seal). Friction loss and turbulence are also greatly reduced because of the "316's" straight full round flow passage. Features like these have made Rockwood the most dependable name in Ball Valves.

The new Rockwood "316" comes with various types of seats, remote air-operation of wanted sizes, 3/8" through 2" screwed ends, 3", 4", 6" and 8" flanged ends. 600 W.O.G. minus 100°F to 400°F. And it's just one of a complete line of Rockwood Valves and Unions.

Write for Rockwood's new catalog—the inside story of Rockwood Ball Valves is worth knowing. Tested and listed by Underwriters' Laboratories, Inc. Distributors in all principal industrial areas.

ROCKWOOD BALL VALVES





ROCKWOOD SPRINKLER COMPANY

1064 Harlow Street, Worcester 5, Massachusetts



Send me your new Rockwood Full-Flow Ball Valves Catalog No. 57.

City......Zone....State.....

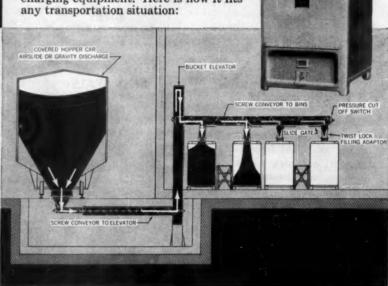
CHEMICAL ENGINEERING—October 20, 1958

# in bulk handling...

# TOTAL SYSTEM

# offers GREATEST transportation flexibility

Tote, a complete, mechanical, automatic bulk handling system, is based on metal bins (aluminum, stainless or carbon steel, monel, or magnesium) plus filling and discharging equipment. Here is how it fits any transportation situation:



# BULK HOPPER CARS

Tote System can be adapted readily to the use of bulk covered hopper cars, of the gravity discharge or Airslide type, when these are furnished free by the shipper or by the railroad.

The drawing above shows how quickly and easily mechanical or pneumatic car unloading and Tote filling equipment moves the contents of the car into Tote Bins. The Bins can then be weighed and placed in your warehouse. (Only with Tote

#### CONTAINER CARS

This special railroad car carries 26 Bins which can be filled by your supplier while still on the car. At your plant or team track, one man with a fork lift can unload the car in 35 minutes. A mileage allowance of 3.7 cents is paid for every mile this car travels.

can you weigh your incoming material as a check against your supplier's invoice and also for inventory purposes.)

One man can handle the entire operation — unloading the car, filling, weighing, warehousing the Bins, and moving previously filled Bins from warehouse to discharge stations. In many installations, 100,000 pounds of material are being moved through the complete cycle in less than four hours by one man.

#### TRUCKS

If bulk hopper trucks are employed, they can be unloaded into Tote Bins by the same method used to unload rail hopper cars. Or up to 16 Tote Bins, depending on weight restrictions, can be carried on conventional trucks and trailers.

Why not let our engineers survey your plant at no obligation? Meanwhile, write for new catalog containing complete details

\*Tote and Tote System Reg. U. S. Pat. Off. TOTE SYSTEM, INC.

600 SO. 7TH

BEATRICE, NEBRASKA

# A COMP WATER WATER

can flow through the NEW Layne 134 shutter screen

WHY? Increased inlet area!

Here's a screen that is even more efficient ... has greater strength than the long-lasting Layne 96 shutter screen that made Layne water wells famous.

This new development of Layne creative research is used only in Layne water well installations, and available exclusively through Layne Associate Companies.

> Contact your nearest Layne Associate Company for complete details.

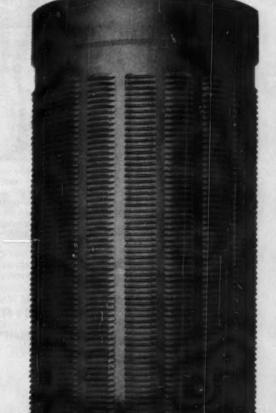


General Offices and Factory Memphis 8, Tenn.

Layne Associate Companies throughout the world.

WATER WELLS

VERTICAL TURBINE PUMPS . WATER TREATMENT





Overhead view of 45,000 cmp a-c bus feeding bank of graphitizing furnaces at Stackpole Carbon Company. Bus is interleaved to reduce reactance drop. Insulation is Transite,

# FIRST-CLASS AVENUES FOR YOUR AMPERES

R&IE's broad experience in low voltage bus design and fabrication—for electrochemical and electrothermal processes—means high current distribution systems that are easier to install, longer lasting, and trouble-free. And, by supplying a fully detailed set of assembly and installation drawings with each system, R&IE assures simpler, lower-cost future expansion.



Experienced R&IE bus design engineers are available to join in your early planning. Their knowledge can help reduce costs . . . improve system performance. They will determine the most suitable materials, protective finishes, bus size and configuration. Later they will provide sound solutions to design problems such as bus support spacing for maximum short circuit protection, provision for structural misalignment, and proper application of disconnecting switches.



Skilled workmen, using specialized machinery, produce bus components accurately and efficiently, assuring low production costs and fast, trial-and-error-free installation. R&IE shop personnel are thoroughly familiar with the fabrication of aluminum and copper. And they have at their disposal a full range of specially adapted tools and machinery for highly accurate cutting, punching, forming, welding and assembling bus, disconnecting switches and flexible bus connectors.

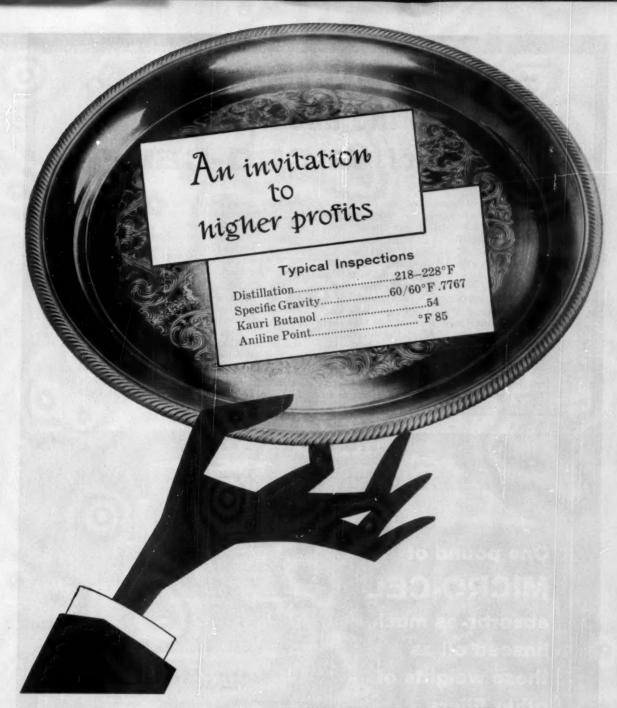
For complete information about R&IE's low voltage bus design and fabrication service, write for Bulletin 1220C, or contact your nearby I-T-E sales office. In Canada: Eastern Power Devices Ltd., Port Credit, Ont.





I-T-E CIRCUIT BREAKER COMPANY

R&IE EQUIPMENT DIVISION . GREENSBURG, PA.



# ESSO LAKTANE RSVP

Here's an unusual solvent in search of further uses. Wherever you need a high-solvency, fast-drying solvent with controlled evaporation, a "clean" odor, low residue, and reasonable price, we suggest that Esso Laktane may well be able to cut your costs and improve the results. A product of Esso Research, it is already the proven quality-leader in rotogravure printing and in the lacquer industry. But we think you'll be interested in its uses in producing neoprene rubber products and vinyl organosols, among many other potential uses. With uniform quality and immediate availability as well as low cost, you'll find that you are indeed answering an invitation to higher profits. Esso Standard Oil Company, Inc., 15 West 51st Street, New York 19, New York.



PETROLEUM SOLVENTS

# You need 14 pounds of talc to equal the absorption of 1 pound of MICRO-CEL SYNTHETTE CALCULUS ALLEGATES

 No matter what your absorption problems may be, chances are you'll find the answer in Micro-Cel—Johns-Manville's new line of synthetic calcium silicates.

Pound for pound, Micro-Cel gives you far more absorption than common fillers like talc and clay . . . even outperforms products like silica gels selling for as much as 10 times Micro-Cel's delivered cost of 8¢ to 10¢ per pound.

Dollar for dollar, Micro-Cel's high absorption also wins out over both low cost and high cost fillers. Only 28¢ worth of Micro-Cel will convert a full gallon of liquid to a dry free-flowing powder. As little as 12¢ worth provides ultimate absorption of a gallon of water.

Industry is putting these properties of Micro-Cel to work in several types of applications: as an absorptive carrier to convert a liquid to a dry free-flowing powder; as a means of drying semisolids to desired degree; to disperse liquids uniformly in a dry compound; to absorb moisture and reduce drying costs; to control liquid viscosity up to a paste or semi-solid; to assure good free flow properties of deliquescent crystals or powders.

Micro-Cel, the powder that flows like a liquid is a new line of inert synthetic calcium silicates produced by combining lime with diatomaceous silica under carefully controlled conditions. In addition to high absorption, it provides particle size as small as .02 micron and bulking action up to a full cubic foot for every three pounds.

For further information, samples and technical assistance, write to Johns-Manville, Box 14, N.Y. 16, N.Y. In Canada, Port Credit, Ontario.





# Is your future on paper now?

YOUR FUTURE BEGINS with an arc and a line, with dimensions and specifications. How your future extends from these plans on paper de-pends largely on the skills and facilities of the men who build from these masterful markings.

One thing is sure. For your petrochemical processing equipment, you can depend on the skills and facilities of Bros Incorporated—steel plate fabricators for the nation since 1882.

Fractionating towers, pressure vessels, autoclaves, stacks and storage tanks—these are some of the special fabrications of large and small capacities that Bros builds. All in a long tradition of exact conformance to prints and specifications.

And, if you need expert assistance in the planning and design of your process equipment, the Bros team of 350 engineers, designers and specialists in steel plate fabrication are yours to command.

Bros has modern shop facilities for welding and working steel plate up to 2" thick. Fabrications conform to all accepted code requirements. X-ray and annealing facilities, too, are avail-

When required, skilled Bros field crews go where needed to erect units too large for such limiting conditions

as shop and shipping clearances.

Today more and more industries are looking to Bros for their steel plate fabrication needs. So if your future is on paper, now is the time to bring Bros into the picture.

Bros also manufactures package and field erected boilers and stokers to supply all your steam generation requirements.

Call your Bros sales engineer today!

#### **BROS NATIONAL DEALERS**

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LYNCHBURG, VA.—
The Campbell King Co.
NASHVILLE—Power Specialty Co.

NORWOOD, N. J.— Eastern Power Equip. Corp. OMAHA—Pioneer Pipe & Supply Co.

Omaria—Flores Pipe & Supply Co.
RIPON, WIS.—Yates Equip. &
Supply Co.
ROCHESTER, N. Y.—Automatic
Combustion Equip. Co.
SALT LAKE CITY—James J. Burke Co. SEATTLE-Superior Engineering Co. TULSA-Bagwell Company

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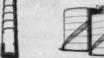
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AUTOCLAVES



FRACTIONATING TOWERS



pipe coils are old fashioned...

modern PLATECOIL® cuts heating and cooling costs

low installation and maintenance costs greater heat transfer efficiency lower space requirements



Write for free Bulletin P-61 "HOW TO CUT HEAT TRANSFER COSTS WITH PLATECOIL" for complete information.

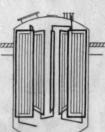
# SHELL CHEMICAL uses PLATECOIL® in synthetic rubber reactors

Stainless steel PLATECOIL units remove heat liberated in synthetic rubber polymerization reaction at the Torrance, California plant of Shell Chemical Corporation.

High efficiency, low cost per unit surface, ease of cleaning and improved agitation are cited as benefits obtained through use of PLATE-COIL in this application.

The PLATECOIL units were fabricated into vertical banks which appear in the photo taken looking down into the reactor. The other photo shows the top of the reactor with PLATECOIL units in the foreground before installation.

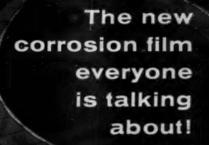
Tranter PLATECOIL units are available in a variety of metals and finishes, in factory fabricated banks and in styles rolled to specified diameters to conform with the curvature of tanks or vats.





TRANTER MANUFACTURING INC.

PLATECOIL



FOR

Here is an authoritative film that answers many questions on the theory of corrosion and demonstrates methods by which it is controlled. Presented in color and sound, it ranges from the formation of anodes and cathodes through the use of galvanizing, inhibitors, metallizing, cathodic protection, alloys and protective coatings. You will see how many corrosion problems in industries such as yours are being solved by Dimetcote, a one-coat zinc silicate protective coating. This film will be well worth 19 minutes of your time. To arrange a showing for you and your associates, or to learn when it will be shown in your area, contact any of the Amercoat offices listed below.



#### Typical audience reactions:

Bishop, Tex.—"Planning fair-sized test after seeing this film."
Louisville, Ky.—"Answers many questions. Second showing arranged."
Cincinnati, Ohio—"Key personnel evidenced considerable interest."
Netherlands Antilles—"Both shows led to 45-minute discussions."
Fairport, Ohio—"Very interesting. Will try methods shown."
Las Piedras, Venezuela—"Putting ideas to work in near future."
Bartlesville, Okla.—"Viewed by 42 key men from five divisions."



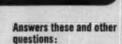


Dept. AJ • 4809 Firestone Boulevard South Gate, California



• 921 Pitner Avenue • Evanston, Illinois • 2404 Dennis Street • Jacksonville, Florida

360 Carnegie Avenue • Kenilworth, New Jersey
 6530 Supply Row • Houston, Texas



What produces electrolytic corrosion?
What factors favor hot-dip
galvanizing?
How important is surface preparation?

Can a coating offer cathodic protection?

What are the corrosion problems on offshore rigs?

What are the advantages of zinc silicate?

How can chemical plants cut painting costs?



One of two Permutit Automatic Valveless Water Filters at O. M. Scott & Sons Co. Chemical Products Plant, Marysville, Ohio. Each filter is 7' diam. and rated at 116 gpm. The complete Permutit water-treatment system was engineered by H. A. Williams and Associates, Columbus, Ohio.

# "No maintenance or operating expense with our PERMUTIT Valveless Filters"

- These filters have been operating continuously for over a year and a half ... supplying water for process, boiler feed and drinking. They follow a Permutit Precipitator that treats raw well water with lime, soda ash and coagulants. Either filter can handle full feed rate during inspection or repairs on the other.
- Here's how Glenn L. Moll, Scott's Service Manager, puts it: "Our Permutit Automatic Valveless Filters are operating very satisfactorily. The filterbed and underdrain system stay clean with no evidence of blow holes or sifting of filter media to the underdrain system. We now inspect them only twice a year."
- The Valveless Filter is completely automatic—yet costs up to 45% less than conventional automatic gravity filters because it uses no expensive valves, flow controllers, pumps or hydraulic or pneumatic control systems.

Send for descriptive bulletin. Address: The Permutit Company, Dept. CE-10, 50 West 44th Street, New York 36, N.Y. or Permutit Company of Canada, Ltd., Toronto 1, Ontario.

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Water Conditioning
Ion Exchange • Industrial Waste Treatment

# U.S.I. CHEMICAL

A Series for Chemists and Executives of the Solvents and Chemical Consuming Industries

Ion Exchange Resins Act

As Catalysts in Acetone

Cyanohydrin Production

Acetone cyanohydrin can now be made experimentally by reacting acetone with hydrogen cyanide in the presence of anionic ion-exchange resins. These resins perform effectively as heterogeneous catalysts for the reaction, research workers have discovered.

However, a way must be found to prolong

their process life before the transition to a successful commercial operation can be made. A two-stage continuous flow reactor has already

been developed in anticipation of a rapid solution to the problem. It employs a feed of

acetone and hydrogen cyanide in the mole ratio of 5:1. At 25°C, 99% conversion is achieved. This feed ratio is required to prevent swelling of the resin, moderate the evolution of heat, and displace the equilibrium in favor

The principal use of acetone cyanohydrin is for the preparation of alpha-methacrylic acid and its esters which are polymerized to

of acetone cyanohydrin.

form methacrylate resins.

# Coppedge Named President of National Distillers

Bierwirth Elected Chairman

John E. Bierwirth, president of National Distillers and Chemical Corporation since 1949, has been elected chairman of the board, and Roy F. Coppedge, Jr., 43, an executive vice-president since May, 1957, has been elected president. The office of chairman has been vacant since 1953.

In their new posts, Mr. Bierwirth and Mr. Coppedge will guide company policy and direct operations. The move was made to provide a broader executive base for the company's growing, diversified business. Net sales in 1957 were \$539 million as against \$470 million in 1952. Industrial chemicals, petrochemicals and special metals currently account for more than 40% of total operating profits. Total investments in these areas now \$190 million



John E. Bierwirth

Roy F. Coppedge, Jr.

# **Unique Brake Throttles** Flow of Sodium Coolant

Engineers working on the Sodium Reactor Experiment (SRE) at Santa Susana, Cal. have brought a unique solution to the problem of reducing flow of liquid sodium coolant while minimizing thermal stresses on the sodium piping and heat exchanger systems. Flow reduction is sometimes necessary to control rate temperature change in the reactor core.

Two eddy current brakes — one on the secondary, nonradioactive sodium loop, and the other on the outlet side of the primary loop — straddle the coolant pipes and throttle sodium flow from 1,200 gpm to 12 gpm in two seconds. Thermal stresses on the system are kept well below any damaging level using this braking method.

# Attention: Users of Tax-Free Alcohol

The Revenue Ruling covering storage of tax-free alcohol has been expanded for purposes of clarification. The regulation previously stated only that a storeroom which can be securely locked must be provided, of sufficient capacity and substantial construction.

The expanded ruling-No. 58-207-adds that these storerooms may also be used for other supplies, provided they are separated from the alcohol, and provided their presence does not interfere with the proper accounting and safety of the alcohol.

# **Automation Takes Over** Communications at U.S.I.; **Speeds Chemicals to Customers**

Unique New Teletype System for Communications and Electronic Data Processing Links 40 Locations Via 7.500 Miles of Wire. Sales and Plant Personnel Freed of Paper Work.

Taking a cue from the automatic operations of its many chemical and petrochemical plants, U.S.I. has recently extended automation to the clerical side of

its business with a tailor-made teletype and data processing system designed primarily to accelerate delivery of chemicals to U.S.I. customers. Specifically, it does these jobs:

- · Completes order processing and invoicing with a single typing.
- · Is instrumental in production scheduling. · Compiles sales, order and production sta-
- · Provides statistics for budget and inventory
- control. · Handles administrative messages.

U.S.I.'s new teletype setup interconnects 40 plants, shipping points, sales offices and company headquarters in a 7,500-mile network among 27 cities. It is integrated with standard punched-tape coding and programming equip-ment, that allows immediate reproduction of an original message anywhere along the line. It also acts as an integral part of an electronic data processing operation which makes information currently and simultaneously available to management, sales, production, research, credit, traffic, accounting

# **Phosphoric Acid Shows** Promise as Soil Stabilizer

Recent studies have revealed that 1-10% by weight of phosphoric acid stabilizes the fine-grained soils which must frequently be used as foundations for roads, dams and air-strips, and improves the ability of these soils to hear loads. Until these studies were made-no really satisfactory means had been found for solidifying fine-grained soils, which have strength when dry but not when wet.

Phosphoric acid seems to act by forming an insoluble phosphate glass from particles of alumina and silica in the soil. It can be employed in low concentrations, costs little, works fairly rapidly. Soils cured for a few hours under humid conditions achieve high strengths after several days, and very high strengths after a few weeks.

Depending on the initial water content of e soil being treated, it may be necessary to add small amounts of other materials such as fluosilicates for faster cure and maximum wet strength of the stabilized soil.

#### One Typing Completes Order Handling

Here's how it works. Say an order for ethanol is placed in Chicago. An order form is made up at the sales office. In this operation a tape is produced which transmits complete information to the shipping point at complete information to the shipping point at Tuscola via teletype. Here the tape automatically produces combination shipping papers and the invoice. At the same time, the information in condensed form is sent to New York and converted to punched cards for data processing.



Girls at a U.S.I. sales office producing transmittal tapes for orders. Most information is transferred automatically to the tapes from repetitive data tapes and cards.

Oct.

# **U.S.I. CHEMICAL NEWS**

\*

1958

#### CONTINUED

### Automation

This new automation is proving invaluable to company and customers alike. When a customer needs some special product or rush service, the U.S.I. salesman, relieved of detail by the automated communications system, is free to set an all-out effort in motion to deliver what the customer needs when it's needed.



Switching center at Cincinnati. Here order and message tapss are received from sales offices for redirection to New York headquarters and shipping points throughout the country.

# Esters of Alkyl Aryl Phosphoric Acid Cut Static on Polyethylene

Polyethylene articles with a greatly reduced tendency to accumulate electrostatic charges can be made by incorporating certain esters of alkyl aryl phosphoric acid, according to the claims in a recent British patent. In addition, on polyethylene film and sheeting, these esters are said to reduce static without increasing slip or wettability, as do certain nonionic surfactants used for the purpose. They do not affect the flexibility, water and chemical resistance, strength or heat-sealability of the resin in any way, it is asserted.

The ester is uniformly distributed on the surface of the polyethylene in one of two ways. It may be thinly coated onto the surface of the finished article from solution in a volatile solvent, in the amount of 5 to 100 mg/sq.

yd. of surface; or it may be incorporated into the granular resin by milling before fabrication, in the amount of 0.05 to 0.25% by weight.

The resulting articles exhibit little or no static, even after prolonged application of friction, according to the patent, and can be surface-treated by usual methods for better bonding with printing inks.

# "Atoms-for-Peace" Show Great Success at Geneva

#### **Mallory-Sharon Among Exhibitors**

The U.S. Atomic Energy Commission and 50 U.S. industrial firms participated in the commercial exhibition held September 1-14 at the Palais Des Expositions, Geneva, Switzerland in conjunction with the second United Nations International Atoms for Peace Conference.

Focal point of the American section of the exhibition was a full-scale model of the core of a 150,000 KW atomic power plant. A rotunda surrounding the model contained an information center and displays telling the overall story of the U.S. atomic industry. On either side of the rotunda were the exhibits of the 50 participating U.S. companies.

Objectives of the American exhibition were twofold: First, to demonstrate that U.S. industry and government are working co-operatively in the field of atomic energy. Second, to show that in the U.S. atomic energy is a practical reality.

Highlights of the American section were two "live" atomic reactors of the research and training type; a completely equipped, mobile radioisotope laboratory; the showing of atomic energy films; a display of U.S. technical publications; and a new "master slave" robot.

Mallory-Sharon Metals Corporation, Niles, Ohio — world's largest integrated producer of reactive metals — was one of the principal exhibitors at the show. The company, owned one-third by U.S.L's parent company National Distillers and Chemical Corp., devoted its display to zirconium for structural and cladding purposes in thermal reactors and to hafnium for control rods.

#### TECHNICAL DEVELOPMENTS

Information about manufacturers of these items may be obtained by writing U.S.I.

Ethanol as a nutrient for cattle, dairy animals and sheep is discussed in a 4-page reprint now available. The alcohol is reported to accelerate runen microflora metabolism, increasing protein synthesis and co.iulose digestion.

Diethylene glycol dimethyl ether described in new technical bulletin as anhydrous reaction medium for organometallic reactions, solvent for inorganic salts, and for use in synthesis of organoboranes and boron-nitrogen polymers. No. 1401

Technical reports made on polyethylene from 1929 to 1957, and now available from the Office of Technical Services of the Dept. of Commerce, are all listed in a 4-page catalog available from Govt. Printing Office for 10\$.

Copper complex fungicide now offered in pilot plant quantities may also serve as rodenticide. Field tests indicate effectiveness on wide variety of harmful organisms in concentrations between 0.005 and 0.05 per cent.

No. 1403

Corrosion-resistant metallic filters for fuels and other compounds such as hydrogen peroxide, hydraxine, ethylene oxide and liquid oxygen can now be obtained. Wide range of flow rates and mesh sizes available.

No. 1494

C<sup>14</sup>Labeled isociane (2.2.4-trimethylpentane-2.4-C<sup>19</sup>) is now available for hydrocarbon and petroleum research on combustion, and for kinetic and mechanical studies. Specific activities to 5 millicuries/millimole can be made. No. 1405

New all-polyethylene acid pump now on the market attaches to any 5-pint reagent bottle. Consists of pump body with relief valve, siphon, spout and 4-ounce squeeze bottle. Claimed to deliver 1,000 milliliters per minute. No. 1406

Ion exchange resins are discussed in recently up-dated book which can now be purchased. In 465 pages, the book provides detailed information on the nature and preparation of all types of ion exchange resinous materials.

No. 1407

New silicone rubber compound, reported to be toughest 25 durometer material now available, is suggested for molded and extruded seals, low pressure gaskets, cushions, other parts. Offers tensile strengths up to 1,000 psi.

New optical goniometer identifies crystalline substances by simple external measurements of interfactal angles. Catches reflections from varicus faces in telescope moved around crystal. Claimed accurate, easy to operate.

#### PRODUCTS OF U.S.I

Alcohols: Ethyl (pure and all denatured formulas); Proprietary Denatured Alcohol Solvents SOLOX®, FILMEX®, ANSOL® M, ANSOL PR.

Organic Solvents and Intermediates: Normal Butyl Alcohol, Amyl Alcohol, Fusel Oll, Ethyl Acetate, Normal Butyl Acetate, Diethyl Carbonate, DIATOL®, Diethyl Oxalate, Ethyl Ether, Acetane, Acetacaceinilide, Acetacacei-Ortho-Chioranilide, Acetacacei-Ortho-Toluidide, Ethyl Acetacacetate, Ethyl Benzoylacetate, Ethyl Chloroformate, Ethylene, Ethyl Sodium Oxalacetate, Sodium Ethylate, ISOSEBACIC® Acid, Sebacic Acid, Urethan U.S.P. (Ethyl Carbamate), Riboflavia U.S.P., Pelargonic Acid, 2-Ethyl Heptanoic Acid.

Pharmacoutical Products: DL-Methionine, N-Acetyl-DL-Methionine, Urethan USP, Riboflavin USP, Intermediates.

Heavy Chemicals: Anhydrous Ammonia, Ammonium Nitrate, Nitric Acid, Nitrogen Fertilizer Solvtions, Phosphatic Fertilizer Solvtion, Sulfuric Acid, Caustic Soda, Chlorine, Metallic Sodium, Sodium Peroxide, Sodium Sulfite, Sodium Sulfate.

#### PETROTHENE® Polyethylene Resins

Animal Feed Products: Antibiotic Feed Supplements, BHT Products (Antioxidant), Calcium Pantothenate, Choline Chloride, CURBAY B-G®, Special Liquid CURBAY, VACATONE®, Menadione (Vitamin K<sub>3</sub>), DL-Methionine, MOREA® Premix, Niacin USP, Riboflavin Products, Special Mixes, U.S.I. Permadry, Vitamin B<sub>18</sub> Feed Supplements, Vitamin D<sub>3</sub>, Vitamin E Products, Vitamin E and BHT Products.

# U.S.INDUSTRIAL CHEMICALS CO.

Division of National Distillers and Chemical Corporation 99 Park Avenue, New York 16, N. Y.

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# The Chemical Engineer keeps 83 million women beautiful

Soaps and perfumes, lipstick and cosmetics
... more contributions to the better life
made possible by the Chemical Engineer
and his technology ...

In industries using chemical processes and techniques . . . their products range from explosives to cosmetics . . . the one unifying influence is the active presence of the chemical engineer and his technology. These industries buy big . . . a third of all capital goods, \$46 billion in raw materials and fuels . . . and it's the chemical engineer who rec-



ommends and specifies as processing needs turn into orders. Sell him *first* and you've sold the common buying denominator of the Chemical Process Industries.

Only one magazine, CHEMICAL ENGINEERING, is aimed exclusively at the chemical engineer, whatever his function. And it's preferred by a solid 3 to 1 margin among chemical engineers in all functions, in all industries. This year you can talk to them with a greater frequency, timeliness and impact than ever before. CHEMICAL ENGINEERING, A McGraw-Hill Publication, 330 West 42nd St., New York 36, N. Y.

Published every other monday for Chemical Engineers in all functions

# **2 NEW ADVANCES**

... in Eye Protection

...in Respiratory
Protection



... for Splash, Spray and Impact Exposures

Developed in conjunction with E. I. duPont de Nemours and Company this American Optical goggle is recommended for protection against splashing liquids, spray and the impact of flying foreign particles. THE GOGGLE IS PARTICULARLY RECOMMENDED FOR USE IN THE CHEMICAL IN-DUSTRY AND WHERE HUMID CONDITIONS PREVAIL.

# AO R-9921 POCKET RESPIRATOR

A "bit type respirator" — exceptional in performance, low in price, compact (3" x 3" x 2¾"). Light-

weight (4 oz.). Long Service Life. Multiple Protection. Noncorrosive. Practically Indestructible. Easily Dismantled. Easily Sterilized. Has complete inhalation and exhalation valve systems. Replaceable parts if needed. 3 companion models. Any of the 12 filter cartridges used in the AO R-5000 series respirator fits the pocket respirator.



 Indirectly ventilated — no vents in frame or holes in lenses to allow splashes or particles to enter. Yet tests indicate the "710" is twice as fog-free as similar goggles.

Protection from Splash and Fumes

· Lightweight, comfortable.

 Wide angle vision for greater safety and work efficiency.

 Fits over all types of personal and safety R glasses.

Frame molded from non-irritating, non-toxic clear vinylite plastic.

 All parts replaceable — frame, lens, and all-rubber headband. (Hence goggle is easy to clean and sterilize.)

 Lenses are impact resistant plastic and conform to high safety and optical standards. Available in clear or green.

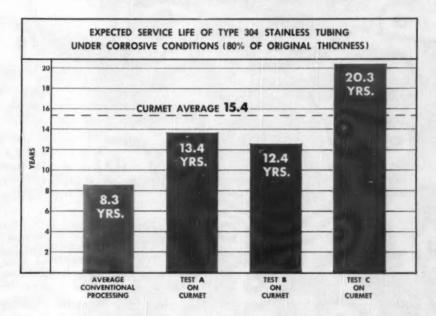
Your nearest AO Safety Products Representative can supply you. Always insist on by Trademarked Safety Products.

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# CURMET

for new levels of Corrosion Resistance in standard stainless steels



Tests by three CurmeT customers\* confirm the findings of Curtiss-Wright's own Metals Processing Division laboratories: CurmeT extrusion imparts substantially greater corrosion resistance to stainless steel alloys.

For the results shown graphically above, test samples of conventionally wrought and CurmeT extruded material were subjected to the standard boiling nitric acid (Huey) test in accordance with ASTM specification A-262.

The tests were made in relation to requirements for nuclear power installations of tubing and fittings. The increased service life that can be expected with CURMET processed stainless is attributed to a homogeneous micro-structure not attained by other methods of conversion. It is achieved at no sacrifice in tensile strength, ductility, impact strength or other property affecting performance of the product.

\*Names on request

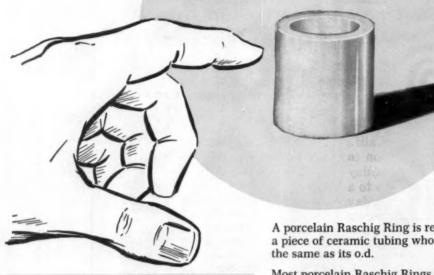
FOR FULL INFORMATION, WRITE TO:

METALS PROCESSING DIVISION
760 Northland Avenue



CURTISS-WRIGHT CORPORATION
Buffalo 15, New York

# What makes a good porcelain Raschiq Ring?



# Do you have these Engineering Data?

As part of our continuing research, U. S. Stoneware makes available a wealth of data helpful to all engineers concerned with the design and operation of Packed Towers. With the exception of the 232 page book-"Tower Packings and Packed Tower Design"-the bulletins are free on request.

- Bulletin S29-R. Complete data on the performance of Intalox Saddle Packing.
- ☐ Bulletin TP-54. Data on all packings of our manufacture, including Raschig Rings and metal Pall Rings.
- ☐ Bulletin TA-30. How to select and install Support Plates and Distributors.
- Bulletin HDP-56. The use and function of Hold-down Plates.
- ☐ Tower Packings and Packed Tower Design. 232 page text book, written by Max Leva, and published by The U. S. Stoneware Co. It is available in a cloth binding for \$8.50 per copy, and in a special paper bound edition for students at \$3.50 per copy.

A porcelain Raschig Ring is really nothing more than a piece of ceramic tubing whose length is generally

Most porcelain Raschig Rings look much alike. But there is a whale of a difference in the way they perform, and the way they stand up in service.

What makes a good porcelain Raschig Ring? And how can you tell?

Physical examination will tell you a lot. Check a number of pieces taken at random from a commercial shipment. (Hand picked samples can mislead you!) Are they uniformly round? Or is there a high percentage of oval rings? Flattened rings will reduce tower efficiency. Check wall thickness. Rings with extra heavy walls (a result of die wear) cut down on column free space, hurt tower performance.

Make comparative lab tests on porosity. Check weight loss from acid attack. Load bearing tests will indicate crushing strength. In making these checks you will be duplicating the routine tests we make on all ceramic rings of our manufacture.

How can you be sure of getting good porcelain Raschig Rings? There are many tests you can make to compare values. But the simplest way to be sure is to buy "U. S. Stoneware."

Address literature requests to Engineering Dept. The U.S. Stoneware Co. Akron 9, Ohio

DEVELOPMENTS ...

OCTOBER 20, 1958

# Chementator

C. H. CHILTON

# Quick freeze puts on the squeeze

Powerful mechanical forces exerted when water turns to ice are being exploited commercially in B. F. Goodrich's freeze agglomeration process for concentrating synthetic rubber latex.

Already used in Goodrich's Shelton, Conn., latex plant, the process has now been licensed to others. Polymer Corp. recently started up a new unit at Sarnia, Ont.; other licensees in Holland and Japan are putting in the necessary equipment.

Object of freeze agglomeration is to increase the size of latex particles so that high-solids-content latex, intended for coagulation to foam rubber, will not exceed a viscosity of 2,000 cp. Conventional way to do this is to slow down the SBR polymerization process. This is costly, besides adding to operating difficulties.

Goodrich's process freezes ordinary SBR latex on the surface of a rotating drum chilled internally with —25 F. brine. Before freezing, latex particles are 400–500 Angstroms dia. Pressures exerted during rapid freezing squeeze the small particles into larger ones averaging 1,500 Angstroms or more. Thinfilm evaporation to 65% solids completes the operation.

# Ziegler chemistry for fatty alcohols

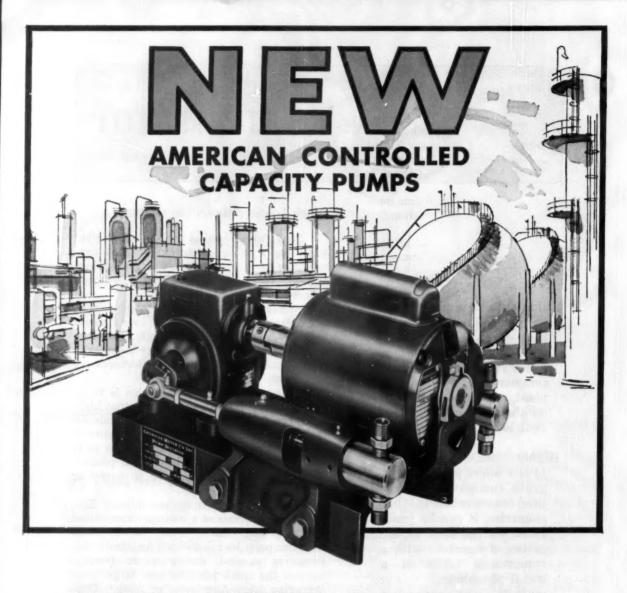
As first disclosed in these columns six months ago (Chementator, Apr. 21, p. 53), Continental Oil Co. has decided to commercialize the Ziegler process for making fatty alcohols from hydrocarbons. Plant size will be in the "multimillion-lb./yr." category; location is not yet determined.

Products will be straight-chain primary alcohols, tradenamed Alfols, containing even numbers of carbon atoms from six through 18, or higher if desired. In the past such alcohols have been commercially produced from natural cils and fats.

Union Oil's new pilot plant at Santa Barbara, Calif., uses solvent extraction to win oil from 200 tons/day of tar sands. Scale-up to a commercial 10,000-ton/day plant will depend largely on ability to minimize solvent losses.

Highly toxic phosphine (PH<sub>3</sub>) offers promise as a grain fumigant. Already used commercially in other countries, it can be generated on the spot by reaction of moisture with a compressed tablet of a metal phosphide.

Spencer Chemical entered the nuclear business last month with startup of a pilot plant for making enriched uranium dioxide nuclear fuel from AEC uranium hexafluoride. Spencer developed its own production process.



## JOB ENGINEERED FOR LONG-TERM ACCURACY AND LOWEST MAINTENANCE COSTS

New American controlled capacity pumps are precision built to meet the needs of Chemical Processing, Refining and Boiler Feed applications. Quality construction assures the highest accuracy in feeding precisely metered fluids or slurries into low or high pressure systems in virtually all desired ratios, with flow, temperature, pressure,

conductivity, PH and other controlled process variables. Control may be manual or automatic — with electric, hydraulic or pneumatic systems.

Newly designed models are available to handle a wide variety of "tough," corrosive and viscous materials, with long-term accuracy and economy.

Write today for full information on American's new controlled capacity pumps. They're sure to meet your fluid proportioning requirements.



company

High Pressure Pumps \* Controlled Capacity Pumps \* Chemical Feed Systems

13500 Philmont Avenue, Philadelphia 16, Pennsylvania

Basic Ziegler process involves the reaction of alpha-olefins with aluminum and hydrogen according to the equation:

 $3R-CH=CH_2+Al+1\frac{1}{2}H_2\rightarrow (R-CH_2-CH_3)_3Al$ 

The aluminum trialkyl is then oxidized by blowing with air, forming an aluminum alcoholate. The alcoholate is finally reacted with water to yield alumina and the primary alcohol. As the equivalent weight of aluminum is comparatively small, aluminum input per ton of product is small if high-molecularweight alcohols are produced.

This process is being piloted in Germany by Harpener Bergbau A. G., Dortmund. Suitable olefins are available from Fischer-Tropsch

operations.

Conoco, however, will start with ethylene instead of long-chain alpha-olefins. (This accounts for the even number of carbon atoms in the Alfols.) In this modification, piloted by Conoco at Ponca City, Okla., triethyl aluminum is first formed from aluminum, hydrogen and ethylene. TEA is then reacted with more ethylene at high temperature:

 $(C_2H_5)_2A1 + 3nC_2H_4 \rightarrow [C_2H_5(C_2H_4)_n]_2A1$ Oxidation and hydrolysis of the long-chain aluminum alkyl again yield the desired alcohol.

## Polyester fiber battle shapes up

Du Pont's enviable commercial success with Dacron polyester fiber has provoked some potentially stiff competition.

Celanese and Imperial Chemical Industries announced late last month that they were forming a joint company to make Teron, a fiber essentially the same as Dacron, at a yet-undecided site in the U.S. Production is expected to be in full swing when Du Pont's patent

rights to Dacron expire in July 1961.

Basic patents are held by Calico Printers' Assn. of Lancashire, England, which invented the polyethylene terephthalate fiber in 1941. CPA sold U. S. rights to Du Pont and rights elsewhere in the world to ICI. ICI has been making Terylene in England since 1949 and has licensed its manufacture by firms in Canada, France, Italy, Germany, Holland and Japan.

The new Teron plant will have a capacity of 40 million lb./yr. Du Pont's Dacron capacity by then will be at least 100 million lb./yr., from its initial Kinston, N. C., plant and one now being built at Old Hickory, Tenn. Back home, ICI plans a new plant to boost its present 22-million-lb./yr. capacity up to 50 million.

British patents expired in July, but protection is still effective while the government considers Calico Printers' request for a tenyear extension. Basis for the request is that the war interfered with normal commercial exploitation of CPA's discovery.

Courtaulds Ltd. filed an objection to the extension. This action stirred up speculation that Courtaulds was planning to come out with its own polyester fiber. But the company (which has a rayon operation in the U.S.)

denies any such specific plans.

Two other, entirely new polyester fibers are being groomed for commercialization by Eastman Kodak and Beaunit Mills. Eastman last month unveiled its Kodel fiber, already in limited production at Kingsport, Tenn. (see p. 82). Beaunit is building a plant in nearby Elizabethton, Tenn., to make 10 million lb./yr. of a yet-unnamed fiber based on a polymer to be made by Goodyear at Apple Grove, W. Va. (Chementator, Apr. 21, p. 53).

## Complex fertilizer made simple

Nitric acidulation of phosphate rock is once again seeking favor among U.S. fertilizer makers. Latest to make the bid is a French process being offered in this country by Vitro Engineering Co., New York.

Developed by Societe D'Auby, the process boasts four well-established European plants,

ranging from 440 to 1.100 tons/day.

Flowsheetwise, the Auby process differs from other nitrophosphate processes principally in the way it neutralizes the acidulation mass and gets rid of hygroscopic calcium nitrate. Auby uses a solid neutralizer consisting of recycled product fines which have been saturated with ammonia. This trick cuts down on the number and cost of neutralization vessels while still avoiding reversion of soluble phosphates to insoluble tricalcium phosphate. Calcium nitrate is taken care of as soon as formed in the acidulation step by adding potassium or ammonium sulfate to the charge.

Nitric acidulation got a lot of attention in the U.S. during the sulfur shortage of 1950-51 because it promised to free phosphate fertilizer producers from absolute dependence

on sulfuric acid supplies.

But before nitric had made any substantial headway, the sulfur shortage was over and most fertilizer makers were content to stick

(Continued on page 64)

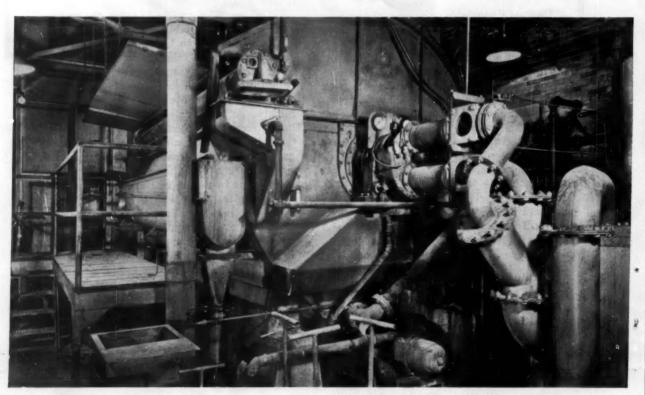
# HOW MARATHON MAKES MONEY... FROM A PULP MILL

Chemicals from spent sulfite liquor made in unique plant using Dorr-Oliver equipment

Spent sulfite liquor, the perennial headache of the pulping industry, is a rich source of valuable materials at the Rothschild, Wisconsin, pulp mill operated by the Marathon Division of American Can Company. These materials include vanillin for food flavoring, dispersants for use in rubber manufacture, ceramics and dyeing, as well as a wide range of other products with applications all the way from industrial cleaners to oil well drilling.

To make chemicals from sulfite liquor, a threestage lime precipitation process is used. Initial filtering with an Oliver vacuum rotary filter recovers calcium sulfite, which is recycled to the pulp mill to make cooking acid. Further treatment of the filtrate yields organic acid salts and calcium lignosulfonate, basic raw material for the production of vanillin and various metallic lignosulfonates.

Dorr-Oliver equipment used includes a settling tank for settling out lignin solids in the early stages of the process, a stainless steel continuous rotary filter for removing gypsum after acidification of the organic precipitates and a rotary precoat filter for removing finely divided solids from the effluent after vanillin-making.



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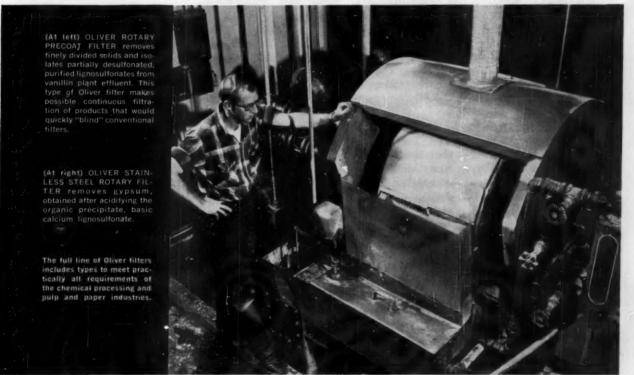
Intensive research to develop materials and markets and the use of the most modern processing equipment to give maximum recovery of saleable products, form the basis of Marathon's successful operation. Output of chemicals now amounts to millions of pounds annually.

The Dorr-Oliver equipment used provides just

another example of Dorr-Oliver's ability to meet highly specialized processing requirements. For information on equipment for your particular needs, just drop us a line—or better still, have one of our specialists call on you. No obligation, of course.

Oliver-Reg T.M. U.S. Pat. Off.





with simpler, conventional superphosphate technology. There were three notable exceptions: Allied Chemical, South Point, Ohio; Associated Cooperatives, Sheffield, Ala.; and California Spray-Chemical, Richmond, Calif. (see Process Flowsheet, Oct. 1956, pp. 358–361).

Vitro's question today: Who'll make it four?

## Sack-stackers vanish from payroll

Manual stacking of bagged products on pallets is a thing of the past for California & Hawaiian Sugar Refining Corp.'s Crockett, Calif., refinery.

A just-completed \$1.6-million materials handling project includes facilities for mechanically palletizing 25, 50 and 100-lb. bags of sugar. Engineered by Lamson Corp., Syracuse, N. Y., this installation for automatically sorting, accumulating and palletizing "floppy" bags is claimed to be a materials-handling "first."

The C&H refinery also put in equipment for mechanical palletization of shipping cases and paper bales. Virtually the entire packaged output of the refinery—about 600,000 tons/yr.—is now handled by the new facilities. An emergency hand-palletization station is on standby, but so far it has found little use.

# Adsorption hits the comeback trail

Improvements in adsorbents, flowsheet and operating techniques have teamed to reestablish adsorption as a commercial method for recovering gasoline and LPG from natural gas.

While the trend has hardly assumed bandwagon proportions, Parks & Dow, Houston consulting firm, reports that since February 1957 seven of its Dryex units have been put into operation, with three more on the way. Units are built by Delta Tank & Mfg. Co., Baton Rouge.

Some of the early natural gasoline plants used charcoal adsorption, but oil absorption pretty well eclipsed the adsorption process by 1930. These departures from the design of early charcoal gasoline plants distinguish the new Dryex process:

 Much smaller and different-shaped adsorption beds.

Much shorter adsorption cycles, e.g.,
 45 min. rather than 2-4 hr.

 A regeneration system which uses a circulating stream of hot (600 F.) natural gas instead of steam.

 Present-day granular adsorbents which are much improved over the adsorbents available 30 years ago.

Units intended for gasoline recovery only use silica gel; where LPG recovery is desired also, both silica gel and activated carbon are used. Consultant Willard Dow points out that today's trend is to large installations recovering both products.

# Close spacing gets close fractionation

Using a novel type of high-efficiency, low-pressure-drop distillation column, the French firm Quartz et Silice has recently started production of boron-10 isotope near Paris.

Like the Hooker-operated AEC plant at Niagara Falls (*Chem. Eng.*, May 1957, pp. 148–150), now shut down, the French plant separates B-10 from B-11 by fractional distillation of a boron trifluoride-ether complex. There are two major differences:

• Quartz et Silice complexes the BF<sub>3</sub> with readily available diethyl ether rather than dimethyl ether. Although the methyl complex is a little more stable and is easier to fractionate, the company couldn't justify building its own DME plant.

• In contrast to the Niagara Falls train of six packed columns, totaling 350 ft. in height, the French plant uses a single 50-ft.-high, 1-ft.-dia. column containing 1,200 plates at ½-in. spacing.

Column is patterned after a Swedish design intended for tall oil fractionation. The plates are solid (imperforate) disks of molybdenum stainless steel, segmented alternately so that liquor descends in a side-to-side flow pattern. While the top surface of the plate is smooth, the underside is baffled, apparently to induce turbulence in the ascending-back-and-forth gas stream. Over-all pressure drop is only 20 mm. Hg.

Capacity of the French plant is 10 kg./yr. of B-10 as 92-95%-enriched BF<sub>3</sub>-ether complex. Waste stream is depleted from its natural B-10 content of 19.6% down to 9%.

Quartz et Silice reports a lot of interest in boron steel for nuclear reactor safety and control rods. If these inquiries lead to orders, the company may expand production to 50 kg./yr. This would require two distillation columns, each 2 ½ ft. dia. and 65 ft. high.

Now! From GENERAL CHEMICAL...Leader in HF Production

# AQUEOUS HF IN NEW, SAFER"DRUM-WITHIN-A-DRUM"



Development of a safer container for Aqueous Hydrofluoric Acid (70% HF) has long been an important objective of chemical packaging specialists. Now General Chemical offers Aqueous HF in a new, safer "drum-within-adrum" which combines the advantages of polyethylene and steel. Developed after more than two years of testing, this drum offers many important features:

Requires no venting! The new drum entirely eliminates venting, since there is no acid-to-steel contact. The all-steel drum presents possibility of danger from hydrogen pressure unless venting is done frequently and regularly.

No corrosion or leakage! One-piece polyethylene construction of inner drum cannot corrode or leak even during long periods of storage. The HF-resistant "poly" drum is fixed firmly inside its steel overpack.

Polyethylene closure seals tightly without "freezing"! Both bung opening and plug are acid-resistant polyethylene. The specially-constructed closure is exceptionally tight, yet simple to operate...eliminates "frozen" closures.

Lower tare weight! The new drum is much lighter than the all-steel container. The 30-gallon size, for example, carries 260 pounds of 70% HF with tare weight of only 40 pounds.

General Chemical is the nation's leading producer of hydrofluoric acid. Producing Works are located at Baton Rouge, La.; North Claymont, Del.; and Nitro, W. Va. Additional packaging locations at Buffalo, Chicago, Cleveland, Pittsburgh, and El Segundo (Calif.)

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DEVELOPMENTS . . .

# PROCESSES & TECHNOLOGY C. S. CRONAN

# Molecular Sieves Make Big Splash in Material Separation

# In Commercial Use Today

Material	Separated From	
Oxygen	Argon	Cuts O <sub>2</sub> below 10 ppm.; cost benefits over older removal methods
Sulfur	Naturalgas	Cuts S from 73 gr. H <sub>2</sub> S/100 scf. to 0.25 gr. (5 MMscfd.) Operating cost: \$14.10/MMscf. gas treated . Invest- ment same as amine scrubbing.
Sulfur	(reformer recycle)	Removes 100 ppm. H <sub>5</sub> S from 5 MMscfh. Saves \$20,000/yr. over amine- scrub
Water	Naturalgas	"Trimmer bed" (5% sieves, rest silica gel) dries 150 MMscfd. gas to 0.05 ppm. H <sub>3</sub> O, vs. 0.15 for all-gel
Water	Hydrogen (reformer)	Sieve layer (40%) in alumina bed ups service life from 1 mo. to 9 mo., at 25% yearly cost for all-alumina
Water	Transformer	Romovers dispersed water without adsorbing additives, too. Not affected by water slugs.
Water	Ethylene	Greater capacity (10%), lower dew- point (-85 F.), same pressure drop
Carbon dioxide and water	Ethylene	CO <sub>2</sub> below 1 ppm., dewpoints below -100 F., at capital costs 30% under scrub-wash-dry systems
Carbon dioxide and water	Nitrogen (generator)	One-half operating cost of MEA absorption, aiumina adsorption. Capital cost competitive



SOUR natural gas is sweetened and dried by these molecularsieve adsorbers operated by Maloney-Crawford Tank & Mfg. Co.

# In Pilot Plants Today

Product	Separated From	
Normalparaffins	Isoparaffins	Partial replacement for alkylation in up grading gasoline
Fissionproducts (volatile)	Melt-refined	Quantitative recovery
Ethylene	Coke-ovengas	Coal-derived olefins not economical in U. S. to date
Acetone	Ethylene	Cleans up after acetylene recovery via acetone-scrub

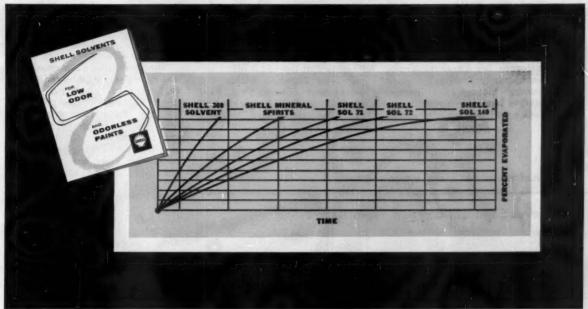
# Sharp, Selective Adsorption Pays Off

Molecular sieves gave adsorption a new technical dimension right from the start. But would they prove economical? Engineers are finding the answer is yes.

Latest news of a commercial breakthrough for molecular sieves, Linde's selective adsorbents, comes from West Texas where Maloney-Crawford Tank & Mfg. Co. is checking use to sweeten and dry 1.25 MM. cu. ft./day of sour natural gas.

Using a dual-bed system, Maloney-Crawford removes sulfur and water in a single pass. Cost is below that for multistep processes like amine scrubbing-caustic washing-alumina drying.

Maloney-Crawford is the first company to disclose a specific installation for removing sulfur compounds with molecular sieves.



Typical properties of these Shell Solvents are contained in booklet shown. It will be mailed on request.

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# SHELL SOL 140

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# SHELL SOL 360

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And the announcement follows close on the heels of last month's disclosure by Texas Co. of a "commercially feasible" process whereby sieves split normal paraffins from isoparaffins to upgrade gasoline to a higher octane

level (Chem. Eng., Oct. 20, 1958, p. 76).

► Gains Roll Up—Still other applications disclosed within the recent past (Chem. Eng., Feb. 10, 1958, pp. 69-72) indicate how molecular sieves are winning

process roles. Among these are drying of pipeline natural gas (Tennessee Gas Transmission) and cat-reformer hydrogen (Sun Oil); removal of oxygen from argon (Linde); coadsorption of CO<sub>2</sub> and water from generated nitrogen (Lindberg Engineering); and recovery of volatile fission products during processing of spent nuclear fuel (Argonne National Lab.). (You'll find the latter development in Chem. Eng., Sept. 8, 1958, p. 58.)

To these may be added other jobs now handled by sieves: Desulfurization of reformer-hydrogen recycle, removal of water and CO<sub>2</sub> from ethylene, drying of fluorocarbon refrigerants, and caging of catalysts and rubber accelerators until they're needed in processing. All are commercial; all give adsorption new importance as a separation tool.

Sieves owe their success to a unique physical structure. Precipitated as crystalline aluminosilicates by a hydrothermal process, they are activated by heat which drives off water of hydration. Even after cooling, they retain their original form which is characterized by geometric networks of voids connected by uniformly sized pores.

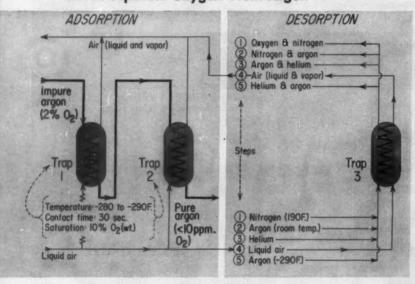
All adsorption occurs selectively in these intercrystalline voids.

▶ Three-Way Split — Molecular sieves separate materials on three bases: molecular size, unsaturation and polarity. The first basis is nearly quantitative; oversize molecules simply cannot enter the pores. The other two are not as specific, relying on relative equilibriums for the order of selectivity of adsorption.

Linde's synthetic zeolites show their sieving action best by reducing oxygen concentration in argon to less than 10 ppm. (see chart and text). But they have won most commercial acclaim in the separation of polar compounds like water, CO<sub>2</sub> and H<sub>2</sub>S. Pick Up Sulfur-Take the Maloney-Crawford desulfurization setup, for example. Maloney-Crawford plans to use dual beds to slash sulfur concentrations in natural gas from 73 grains H2S/ 100 scf. to .025 grains H2Sand gets dewpoints approaching 100 F. Operating cost; about \$14.10/MM. scf. of gas treated,

# A typical molecular sieve operation

# Sieves Separate Oxygen From Argon



LINDE uses molecular sieves to economically adsorb the last few percent of oxygen from argon at one of its major eastern air separation plants. Chief advantage of the sieve process over older methods: It integrates smoothly with low temperature rectification of argon.

Boiling liquid air maintains operating temperatures of -280 to -290 F. in the adsorption beds. Waste nitrogen gas—first at 190 F., then at ambient temperatures—desorbs oxygen from the beds after saturation of sieves (about 10% by wt.).

This nitrogen is absolutely dry-important in view of molecular sieves' avid affinity for water-and is a cheap medium for getting all oxygen out of the adsorbent.

➤ Purge Twice and Cool—Purified (deoxygenated) argon gas purges the bed of nitrogen. Helium then displaces argon prior to cooling to operating temperatures again.

If nitrogen were in contact with

sieves during cooling, some would be adsorbed, reducing sieve capacity and serving later to contaminate argon effluent during oxygen adsorption. Helium might be used to purge nitrogen, but its cost makes readily available argon a better bet to sweep the bed clean. (A small residue of argon in the bed during cooling is tolerable; a small amount of Na is not.)

But why purge argon at all? The answer: Maximum argon adsorption occurs at about —190 F., an intermediate point in cooling cycle prior to adsorption, and would significantly reduce the sieves' capacity to adsorb oxygen. (Size of argon molecule is close to effective pore size of adsorbent. Level of activation energy is critical.)

Very little helium, on the other

Very little helium, on the other hand, is adsorbed during cooling. And helium's high thermal conductivity speeds cooldown of the adsorbent. When the trap is at -280 to -290 F. again, argon purges the helium and oxygen adsorption can be resumed.



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formed with Byers PVC Pipe. We've tested it. We've worked with it. We know what it can do. And what it can't do.

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Write our Engineering Service Department for copy of this new 32 page illustrated catalog on Byers PVC Pipe. including eventual sieve replacement.

In this and other desulfurization jobs, molecular-sieve adsorption competes with monoethanolamine (MEA) scrubbers followed by a drying column. Initial investments are about the same for both techniques, but operating costs may drop 50%.

Sieves find wide usage in drying process gases such as natural gas, reformer hydrogen, and ethylene. Here they back up less costly desiccants like alumina and silica gel to give greater over-all capacity and much lower dewpoints. Main drying load is handled by a common desiccant, followed by a thinner layer or trimmer bed of molecular sieves (@ approx. \$1.50/lb.) in the tower outlet.

Make Mine Dry—Such trimmer beds in two silica-gel towers operated by Tennessee Gas Transmission Co. at Gabe, Ky. lower moisture in natural-gas from 0.15 to 0.05 ppm. Linde claims a mighty important reduction for subsequent low-temperature removal of ethane and higher hydrocarbons. Molecular sieves account for only 5% of total desiccant weight.

At a major petroleum refinery, engineers have extended life of a desiccant bed from one month up to nine months. It's done by using a 4-ft. trimmer bed with a 6-ft. alumina bed for drying catalytic-reformer hydrogen slated for NH<sub>a</sub> synthesis.

Refiner operates with an adsorbent charge that costs only \$16,000/yr. vs. \$66,000/yr. when straight alumina was used. Add to this the cost of changeover and downtime and the case looks even stronger for sieve trimmer beds in drying operations.

A large midwestern producer of polyethylene wanted to step up flow of ethylene-rich gas from 25,000 to 28,000 scfm. through alumina drying beds. Use of larger alumina particles permitted operation at the increased rate with minimum rise in pressure drop. However, the bed couldn't maintain sufficiently low dewpoint for successful ethylene polymerization.

Replacing 10% of the coarser alumina with molecular sieves dropped effluent dewpoints to -85F.

► Two at a Time—Another polyethylene producer, in the Southwest, extracts both carbon dioxide, a catalyst poison, and water from ethylene. Two adsorbent beds containing 15,000 lb. each of molecular sieves treat 2 MM. scfd. of gas to drop CO<sub>2</sub> level from 3,000-4,000 ppm. down to less than 1 ppm., obtain dewpoints below —100 F.

Here, investment cost is estimated to be \$150,000 for the onestep sieve system, \$220,000 for a chemical absorption system (amine scrubbing). Operating costs are comparable, if you assume a service life of 1,000 cycles for the molecular sieves.

Lindberg Engineering, Chicago, Ill., has developed a nitrogen generator utilizing molecular sieves for removal of CO<sub>2</sub> and water. Capital cost of this unit is competitive with those using MEA absorption. Operating costs are much lower because maintenance costs are negligible.

## Water Simulates Gas Flow in Model Tests

Engineers have been building an increasing number of models lately to lick the everpresent problem of uneven gas flow in ducts and electrostatic precipitators (Chem. Eng., Mar. 24, 1958, p. 70).

Latest approach to this problem is to use liquid flow to simulate behavior of gases in precipitator systems. Buell Engineering Co., New York, finds that water flow in scale models closely duplicates gas performance in precipitators it Experimenting manufactures. with design changes on models is much more economical than cut-and-try techniques in the field: firm also finds the water models are less expensive than three-dimensional gas-flow models.

▶ How Model Works—Here's how the water models work: Water table itself is 3 ft. by 5 ft. and is 5 in. deep. A model of a vertical cross section (parallel to gas flow) is built out of metal strips 2 in. high on a scale of ½ or 1 in. to the ft. This two-dimensional section adequately represents the whole unit because gas flow on a horizontal

plane is generally uniform throughout precipitator.

Water, colored with ordinary blue dye, is circulated through model with a \(^4\)-hp. pump. Aluminum powder sprinkled in the water shows flow pattern, indicating eddys and areas of no flow. Motion pictures and time exposures record patterns for future reference.

Vanes and baffles are shuffled around in the model until engineers are satisfied that unit is operating at maximum efficiency. Test results are then scaled up to full-sized units.

Water models were originally developed as trouble-shooting aids for completed units but proved so successful that models are now used in all preliminary design studies.

# New Computer Shorthand Cuts Programming Time

A new technique in computer programming—now being used successfully in U.S. Air Force's Air Materiel Command—eliminates the need to write detailed, step-by-step coded computer instructions for Univac I and II computers, cuts programming and testing time by 88-98%.

Developed by Air Materiel Command and Remington Rand, the "shorthand" technique involves typing out instructions using English language verbs and algebraic symbols, feeding these instructions to a computer which does the detailed coding. Instructions are typed on regular computer tape as simple sentences (sample verbs: vary, compare, transfer) and algebraic equations.

Instructions cause the coding computer to generate the detailed code and to compile and record program on tape.

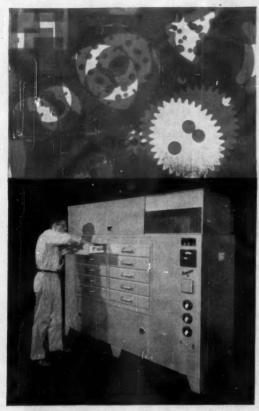
In a typical example, stress analysis, 35 sentences generate 3,600 detailed code instructions. With the new technique, time for programming and testing is eight hours, versus 20 days for conventional techniques.

Technique involves a slightly different "vocabulary" when used for business or for engineering problems; it's called Flow-Matic in the former case, Math-Matic in the latter.

### New oven dries Zytel\* for perfect miniature parts

Raw Zytel Nylon can pick up at least 21/2% moisture just waiting to be molded. The result is miniature and sub-miniature parts that bubble. • This was a serious problem to United Fabricators, Stillwater, Minn. Some of the companies they serve are Bell & Howell, Sylvania Electric, Revere, Longines-Wittnauer and the builders of the Falcon Guided Missile. All exacting customers who won't permit deviations of even thousandths of an inch. • United Fabri-

cators solved their problem with the new Despatch PLHD-2-5 Preheating and Drying Oven. Number 101 Zytel Nylon resin granules are ground up and dehydrated at 175° in the oven. A dessicator removes the moisture from the air. The result is Zytel with less than .2% moisture content, ready to mold into stable miniature and sub-miniature parts. • If you have a similar problem, don't forget that Despatch, the giant of the heat processing industry, is also the leader in laboratory and drying ovens. Despatch can provide you with any type of drying oven ready-made or custom-engineered to your exact specifications.

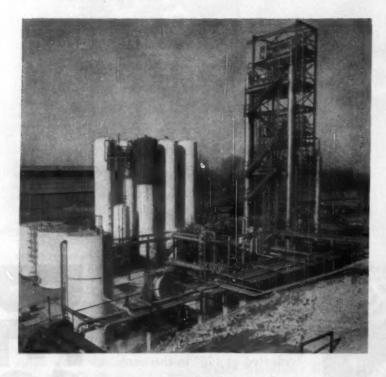


\*"Zytel" is a Dupont Registered Trademark

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### **Engineering Shortcuts Slice Plant Costs**

Cost-conscious engineering saved Commercial Solvents Corp. a pile of cash in the construction of its new methylamines plant (above) at Terre Haute, Ind. Capital cost was "less than \$2 million" for capacity listed officially as "in excess of 5 million lb./yr."

Basic process design for plant and equipment was supplied by J. D. Leonard & Associates, New York. Then CSC, bypassing the "turnkey" contract, did its own detailed engineering and hired local contractors—saved an estimated 40% on engineering charges and 10-15% on construction costs.

▶ Tailored to Market—Leonard methylamines process (Chem. Eng., Nov. 1955, p. 122) operates at pressures above 250 psi., cuts equipment costs 50% compared to the bigger low-pressure systems used in most U.S. plants. Leonard's process (which produces mono-, di-, and trimethylamines) allows for recycle of product that is in weak demand, shifts reaction equilibrium in favor of the more desired amine. Commercial Solvents saved additional dollars with some construction gimmicks: The four distillation columns support auxiliary equipment (see photo) saving space and piping. And even though methylamines plant is classed "hazardous," CSC was able to safely install non - explosion - proof instruments (saving \$90,000) by airconditioning the control room and placing it under slight positive pressure.

► Construction Shortcuts—Another saving: CSC cut construction and maintenance costs by using welded construction, eliminating flanges and bolts.

Even distillation towers are welded into a single piece without entrance man-holes. But Leonard has confidence in this shortcut: Methylamines are corrosion inhibiting and in previous installations, columns have operated for over 15 yr. with no sign of corrosion.

Around 30 million lb./yr. of methylamines are produced in the U.S., for things such as germicides, medicinals and dyes. And a possible large market is opening up in some of the new

missile fuels. Rohm & Haas and Du Pont are the other U.S. methylamines producers, but Pennsalt Chemicals will soon be breaking into market with its nearly completed plant at Wyandotte, Mich.

#### Solar Furnace Uses Patchwork Mirror

Heart of the Army's new solar furnace at Natick, Mass., is a giant patchwork collector made from 180 spherical mirrors mounted on a 30 ft. by 30 ft. frame. Mirrors, each 2 ft. by 2 ft., were made by special sagging technique developed by American Optical Co. which gives each mirror a 472-in. radius of curvature without any special grinding or polishing.

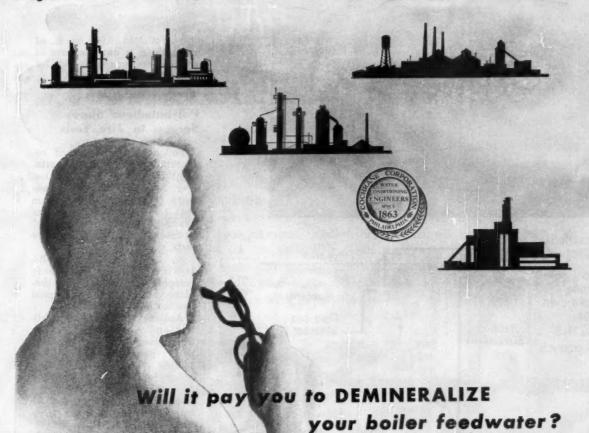
New furnace is designed for high thermal flux rather than extremely high temperatures. Samples placed in the 4-in.-dia. image in test chamber can be heated to around 5,000 F., closely simulating thermal radiation received by material in vicinity of nuclear explosions.

Mirrors are front-surface type rather than conventional back-surface type to minimize heat absorption in the glass. Reflecting surface is vacuum-deposited aluminized material protected by silicon monoxide coating.

#### **Explosives Maker Completes Expansion**

Swinging into continuous production with its new ammonium nitrate plant at New Castle, Pa., late in September, American Cyanamid Co. marked completion of a 60% increase in explosives capacity. American Cyanamid's program has been geared to keeping pace with rising consumption of industrial high explosives by all major consuming indus-

A substantial portion of Cyanamid's effort has been directed at rebuilding and expansion of the 535-acre New Castle plant. New buildings include an ammonium nitrate plant, a warehouse, a maintenance shop, a papershell processing house and several raw-material-preparation units.

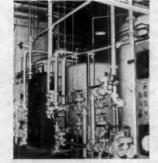


There is no simple answer to that question. From the standpoint of water quality, the superiority of demineralization is unquestioned. It removes dissolved solids, including silica more completely than any other treatment method and is a "must" for high pressure boiler systems. But in some cases the installation and operating cost of a demineralizing system may not be economically justified. Instead, another type water treating system may be advisable, particularly for boilers in the medium pressure range of 750 to 1250 psig.

As we said, there is no simple answer. But there is an easy way to find the answer: Present your problem to Cochrane water treatment specialists. They have designed water treatment systems for industrial plants and utilities with makeup feedwater requirements as high as 8000 gallons per minute! This background and experience in all phases of the art is your guarantee of an expert, impartial analysis and recommendation because, Cochrane engineers and manufactures every type of water conditioning system.

To find out whether or not demineralization is the answer to your feedwater treatment problem write: Water Treatment Division.

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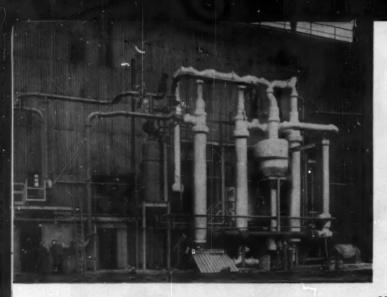
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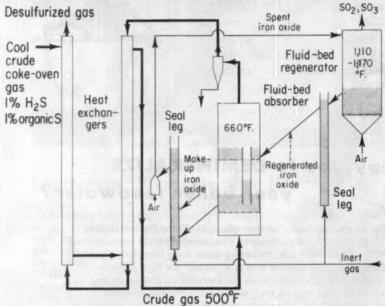
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#### Fluid Bed Desulfurizes Fuel Gas

Here is the pilot plant that launched Appleby-Frodingham Steel Co.'s new approach to desulfurization of fuel gas for open-hearth steel furnaces. Pilot plant demonstrated how modern system could match iron oxide's inherently efficient absorption of sulfur with an efficient operating scheme.

By mid-1959, this British company will be operating at its Appleby Steelworks a 32-million-cu. ft./day gas-desulfurizing plant, scaled up from 2½-million-cu. ft./day pilot unit shown above.

▶ Dual Beds—Process uses dual fluid beds of iron oxide (Chem.

Eng. Sept. 22, 1958, p. 69) to desulfurize coke-oven gas containing approximately 1% H<sub>2</sub>S and 1% organic sulfur. Appleby-Frodingham will convert recovered sulfur to acid in contact plant.

Described No. 10 Post of the control of the control

Sulfided oxide undergoes regeneration many hundreds of times and still retains useful activity. Ultimate rejection from

system of 1 lb./5,000 cu. ft. of gas treated is only because of particle-size attrition, not because of reduced activity.

#### Polybutadiene Shows Success in Tire Tests

Following the flurry of research and development excitement in polybutadiene (Chem. Eng., Aug. 11, 1958, p. 71) comes word from Phillips Petroleum that 1-4 cis polybutadiene has shown "spectacular successes" in truck and passenger-car tire tests.

So heartening are results, says Phillips, that it's already mapping expansion of pilot-plant production and will speed tire testing.

According to officials of Phillips and Armstrong Tire Co., which cooperated in the tests, new polybutadiene rubber (called "Cis-4") consistently out-performed natural rubber. And what's more important, adds Phillips, Cis-4 gives excellent treadwear in truck tires. These heat up less than the corresponding sizes of natural-rubber tires.

#### U. K. Uses No Pressure in Powder Route to Beryllium

Now there's an encouraging word from Britain's Atomic Energy Authority on development work for pressureless powder-metallurgy techniques to produce sintered fabricated beryllium parts. Method is already in use at AEA's Aldermaston research labs.

AEA sees the method as key to an alluring possibility—production of nuclear fuel elements by sintering beryllium powder directly around a uranium ceramic core.

▶ A Plant, Too?—This follows closely an announcement by Imperial Chemical Industries that it will build a plant to produce semifabricated beryllium by a route it describes as "conventional with some variations." It's known, however, that ICI will sinter beryllium powder under vacuum for further processing. And the rest of ICI's

## BULLETIN!

## **POWELL** introduces new member in world's largest family of valves

Powell engineered "Full Flow" bronze valves are now available in a full line: the brand-new 150-pound screwed end Globe Valve, in addition to the well-known 200-300 pound Screwed and the 150-300 pound Flanged Globe and Angle Valves.

Although designed by Powell to assure maximum flow with minimum pressure

drop and internal turbulence, these valves can be throttled to permit only the minutest amount of fluid to pass through. And, if desired, they can be supplied with Indicator Collar, Arm and V-port Disc for quickly determining flow and holding it constant.

Compare these advantages of Powell Full Flow valves:

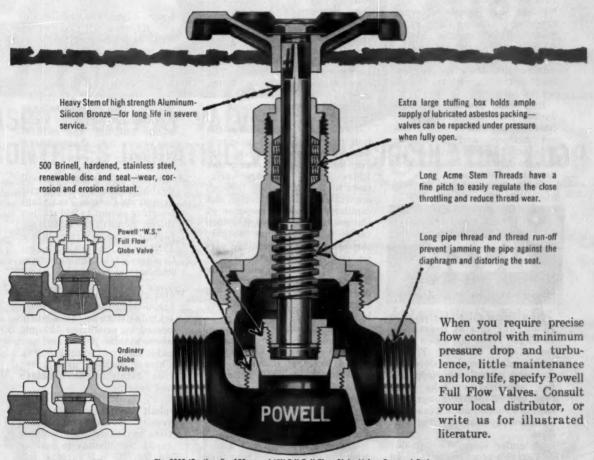


Fig. 2600 (Sectional)—150-pound "W.S." Full Flow Globe Valve, Screwed Ends

THE WM. POWELL COMPANY · Dependable Valves Since 1846 · Cincinnati 22, Ohio

proposed process closely parallels techniques described by AEA.

From Swarf to Minus 200—Here's AEA's description of technique: Electrolytic flake beryllium is purified by vacuum melting and cast into ingots. Turning ingots in a box lathe under inert argon atmosphere produces swarf (fine particles) which is then powdered in stainless-steel ball mills—6 hr. in conventional mill, 20 min. in high-speed centrifugal. Powder thus produced is smaller than 200 mesh.

Powder is handfilled into graphite molds which can be mechanically vibrated (50 cps.) during filling (to 45-50% bulk density). Powder is sintered without pressure at 1,200-1,220 C. for 6 hr. by induction heating of mold. Sintering produces bulk densities of 95-98%.

Range of Shapes — Normal range of products: Bars, cylinders and rectangular blocks. AEA has produced thin-walled (0.12 in.) tubes but shrinkage interference by graphite core leads to trouble with transverse cracking.

Beryllium product is more ductile than that produced by conventional hot- or cold-pressing methods, and product of 98% bulk density is impermeable to hydrogen at temperatures up to 600 C.

Chief disadvantages of technique are greater criticality of powder's particle-size distribution and less control of sintered dimensions than in vacuum hot pressing.

#### Molecular Sieves Win Higher-Octane Gasoline

Now being pilot-planted at a 10-bbl./day rate at Beacon, N. Y., by the Texas Co., a new process (Texaco Selective Finishing) uses molecular sieves to separate normal and isoparafins, promises to take some pressure off octane-hungry refiners. Process, adds Texaco, is commercially feasible at present time.

Molecular sieves (see p. 66) in Texaco's process are tailored to absorb low-octane normal paraffins but reject other components of naphtha or reformate.

Stocks most susceptible to TSF process are light straight-run naphtha and light catalytically reformed gasoline. In tests, octane rating (Research, 3 cc TEL) of naphtha was boosted from 85.5 to 96.6, rating of light cat reformate from 92.3 to 98.2. Furthermore, octane rating of these stocks improves by as much as two numbers during blending.

Too, use of TFS-processed naphtha reduces amount of alkylate needed for blending stock. For a 98-octane paraffinic blending stock, alkylate needs are cut from about 65% when blending with straight-run light naphtha to about 15% when blending with TSF light naphtha.

#### New Stream Analyzers Developed at Oak Ridge

Newest approach to analyzing process streams continuously has grown out of process control needs at the Oak Ridge, Tenn., gaseous diffusion plant. The basic principles seem applicable to other uses.

To monitor UF concentrations ranging from 5 to 40 mole percent mixed with nitrogen, oxygen, fluorine and hydrogen, Oak Ridge detects pressure variations in stream flowing through sequential hookup of orifice and capillary. Pressure response of the gas flowing through orifice varies with molecular weight; through capillary, pressure varies with viscosity. Method should lend itself to measurement of any liquid or gaseous mixture where density or viscosity vary with a change in concentration of the key component.

Major advantage of analyzer, developed by Union Carbide's C. W. Weber and W. S. Pappas, is the fact that it can be constructed of resistant materials to handle corrosives.

A second stream analyzer now in use at Oak Ridge measures and controls the amount of fluorine in a process gas stream. A measured amount of SO<sub>2</sub> mixes with the process gas which then passes through a metal tube heated to 400 F. Fluorine and

sulfur dioxide react to form sulfuryl fluoride.

Change in gas volume, due to reaction, affects flow which causes a pressure response. This is proportional to fluorine concentration in process stream. Instrument controls fluorination tower in conversion of UF, to UF,

#### **NEWS BRIEFS**

Helium: U. S. Department of Interior has now announced that construction will begin at earliest possible date on new helium plant in Keyes natural gas field. Congress has voted \$12 million for plant, which will be capable of processing 70,000 Mcf./day of natural gas (equivalent to 200,000-290,000 Mcf./yr. of helium.

Merger: Signal Oil and Gas Co. and Hancock Oil Co., two of California's largest independent oil companies, are preparing to merge pending stockholder approval, in a deal that would create an integrated firm with assets of about \$500 million. Two companies have domestic production of about 65,000 bbl./day and natural gas sales of about 70,000 Mcf./day.

Acetic acid: Celanese Corp. will double production of acetic acid at its Pampa, Tex., plant boosting output to 240 million lb./yr. Some of the additional capacity, due on stream in late 1959, will be available for Celanese's trimethylolpropane and acrylic esters.

Water-gas synthesis: Red China claims that the Dairen Petro-leum Institute has set a world record by producing 191 gm. of "synthetic petroleum" per cubic meter of synthesis gas. Chinese method uses fused iron catalyst and fluidized bed reactor.

Asphalt decontaminant: University of California scientists have used water-soluble asphalt emulsions to remove up to 97% of surface soil particles contaminated by radioactive fallout.

**SOLENOID VALVES** FOR NUCLEAR REACTORS



CONTROLS ISOLATING VALVE

From ASCO's nuclear energy facilities - the only ones in the Solenoid Valve industry to include a hot test loop - now comes a complete family of solenoid valves tailored to atomic energy requirements.

Typical is the 4-way valve illustrated above designed for the control of the main cylinder-operated isolating (stop) valve in the circulating loop. This stainless steel, packless type (hermetically sealed) valve features exceptionally tight seating—through beveled, poppet-type seats and discs. Solenoid pilot controlled and available with manual override, it is supplied in 1" size. This unit is suitable for 2500 P.S.I. differential pressure at 600°F

Like all other ASCO Solenoid Valves designed for nuclear reactor systems, this valve has passed the most rigid tests under faithfully duplicated working conditions. ASCO 4-way Solenoid Valves are now in use on nuclear submarines powered with water-cooled reactors. Uniformly reliable and maintenance-free, ASCO 2, 3 and 4-way Valves are specified for primary and secondary systems of nuclear reactors, as well as for instrumentation control.

For further information, request "ASCO Valves for Nuclear Reactors" and Catalog No. 202.



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Typical ASCO Solenoid Valves for submarines, military and commercial surface ships, and industrial power plants:

Instrumentation Control **Primary System** Secondary System By-Pass Coolant Valve Valves Valves



Valves

DEVELOPMENTS ...

## CHEMICAL ECONOMICS EDITED BY D. R. CANNON

#### Available Refining Processes Can . . .

#### . . Hike Octane Levels

Refining Process		ustry Us (Perce	-	ess	Octane Numbers Added** (1962 vs 1959)	
		All U. S.		st*	All U. S.	East*
	1960	1962	1960	1962		
		Es.				
Catalytically reform at increased severity (80%).	35	87	50	100	0.48	0.35
Catalytically reform heavy thermal naphtha	15	29	20	60	0.28	0.21
Extract aromatics from reformate; reform raffinate	5	11	10	20	0.24	0.42
Alkylate isobutane, polymerize propylenes	5	20	0	30	0.06	0.09
Isomerize pentanes and hexanes (recycle C <sub>5</sub> )	3	9	5	15	0.21	0.22

Total Octane Increase 1.27 1.29 1962 Octane Level 96.2 98.2

District 1, which, for this study, includes Fla., Ga., S. C., Md., Mass., R. I., Del., N. J., N. Y., Pa., Va., W. Va. \*\* Maximum octane effects (Research) on 1959 gasoline pool, at 3 ml. TEL/gal.

## Spend Octane Dollars on Today's Know-How

Refiners can jack gasoline pools up as much as 0.5 octane numbers/yr. by putting in new capacity for processing techniques commercially available today.

Automotive markets will continue to put insistent pressure on petroleum refiners to keep gasoline octane levels on the rise. Refiners have, however, the tools in hand today to build a good deal more antiknock quality into their product—as much as 0.4-0.5. Research octane numbers (RON)/yr. right through 1962.

They can do this with a "systematic utilization of available processing techniques," Ethyl Corp.'s C. J. Wolf and C. A. Cole in a paper presented to a National Petroleum Assoc. meeting last spring. (Above chart shows the incremental octane-producing potential-at 3.0 ml. TEL/gal.-of five presentday refining practices).

▶ Realistic Spending—The octane-raising techniques Cole and Wolf selected, while their technology is proved, are highcost processes. In order to select the processes and rate of utilization of each, Cole and Wolf had to balance octane-improvement economics against reasonable capital expenditures.

Until 1959 extra octanes can, and will, be picked up by increased use of catalytic cracking, olefin alkylation and catalytic reforming-particularly the reforming of marginal (180-200 F.) light virgin naphtha and heavy distillate naphtha.

► Try Today's Know-How-But for higher octanes in the early 1960s, refiners will have to rely on the following routes:

· Catalytic reforming at higher severity, which yields a debutanized reformate lower in volume but higher in octane. The U.S. refining industry is now running at an average catreforming severity of about 83%. By 1962, 87% of the industry will be cat reforming at 80% (see chart above). Catalyst improvements in the past two years make processing to this limit worthwhile from the standpoint of a better yieldoctane relationship.

· Catalytic reforming of heavy thermally cracked naphtha (240-400 F.) at 80% severity. This will extend cat reforming to the very heaviest thermal petroleum naphthas. Nearly 30% of U.S. refiners, and 60% of those in District 1, will be running heavy naphtha through cat reformers by 1962.

 Extraction of aromatics from catalytic reformate (straight-run charge) followed what

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#### TYPICAL PROPERTIES OF CELANESE BPL

beta-Propio % min.	lactone, wt.,	97
Physical sta	ite	Liquid
Color		Colorless
Odor		Pungent, acrylic
Boiling Poir	it, deg. C.	162
Refractive in	ndex @ 20°C	1.4131
Specific gra	vity @ 20/20°C	1.1490
Pounds per	gallon @ 20°C	9.56
Flash point, deg. F.	Tag open cup,	165

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See Chemical Materials Catalog and Chemical Week Buyers' Guide for complete listing of Celanese Chemical Products.

by reforming of the raffinate. This technique has a very high octane-improvement factor. For included in its effect would be the results of reforming methods which give superior yield-octane ratios, methods like low-pressure reforming with catalyst regeneration.

• Alkylation of all available isobutane, and polymerization of excess propylenes only. It will be 1962, though, before an appreciable portion (20%) of the U.S. refining industry will be alkylating isobutane.

• Isomerization of pentanes (with recycle) and hexanes (once-through). Although a high-powered octane-raiser, isomerization of C<sub>2</sub> and C<sub>6</sub> fractions will not begin to be important to the national gasoline pool until 1962. Butane isomerization will not be a factor at all during the period under study.

#### Soviet Output Today: U. S. Output Years Ago

U.S. passed 1955 Soviet output . . .

Cement	35	yr.	ago
Coal	51		
Cotton fabrics	37		
Crude oil	36		
Electric power	18		
Footwear	44		
Lumber	59		
Steel	41		
Tractors	39		
Trucks	38		

We all made the mistake of underestimating the Russians before Sputnik I. We now run the risk of overestimating them—or at least the risk of not seeing the trees for the forest.

The Soviets are not supermen. They cannot build a top economy with mirrors. They need men, machinery and money in the same prodigious amounts as the rest of the world.

Martin Kohn of McGraw-Hill's Economics Dept. sums up the danger as follows: "We are needlessly awed by the rate of growth of Soviet output. A rapidly growing Soviet economy is in itself no threat to our security anyhow. The real danger lies in the USSR's power and will to concentrate her resources, material and human, wherever she wants, to produce the very best of whatever she wants."

Russia presents a chilling threat—but the threat is in the trees, not the forest.

▶ Really Faster?—Much is made by many of the fact that the Soviet economy is growing three times as fast as our own: 10%/yr. vs. 3%/yr. This is true, or was true until very recently.

But the base for calculations of percentage growth rate is, Kohn points out, far less for Russia than for the U.S. American industrial output is two-and-a-half to three times that of Russia. And our lead in absolute terms is still widening.

By their own admission, the Soviets' growth rate is starting to come back to earth. The Russians report a 10% hike in industrial production last year (they have claimed 12%/yr. since 1951), and expect only an 8% jump this year.

Believe it or not, manpower requirements are beginning to slow the Soviet economic effort. From 1950-56, Russian working-age population grew more than 2 million/yr. From 1956-65, the annual increase will number less than 1 million workers.

Another brake on Soviet capital goods output: the political and economic need to channel more energy to backward sectors of Russian business, such as agriculture and transportation, and to production of more consumer goods.

▶ We Were There—The U.S. passed nearly all Soviet Russia's present levels of output many years ago (see chart above). And we reached those levels in about the same number of years, on the average (27 years, figuring from 1928, when Soviet industrialization really gathered steam, to 1955) in a much earlier and more primitive period in history.

Where impressive overall growth rates, and spectacular breakthroughs in this field or that, really count is in the realm of psychological and military peril.

The Russians propagandize their successes to the hilt; they even run certain parts of their economy to provide this propaganda. Viewed without proper perspective, this talk can be very convincing.

As for the military threat, Kohn views Soviet growth rates, gross national product and industrial production, and how they compare with our own, as "largely irrelevant." "As long as the USSR chooses to utilize advanced scientific and technological achievements to produce revolutionary military weapons, we will remain in serious peril—regardless of how little we or they grow in terms of aggregate product."

#### Chemical Unions May Merge in 1959

Organized chemical labor is on the way to becoming better organized, it seems. And it's not figured to make the chemical engineer's job any easier.

Executives and delegates of the chemical industry's two ton labor unions—Oil, Chemical & Atomic Workers (OCAW) and International Chemical Workers Union (ICWU)—have just approved "a detailed program which will provide a definite timetable of preparations for the merger of our two unions."

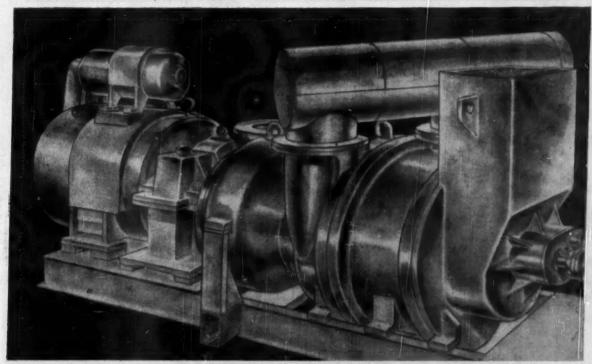
Consolidation of the two unions has long been regarded as a logical move to exert more pressure on chemical industry employees, only 30% of whom are organized. (OCAW has 175,000 members, ICWU about 85,000. Each has about the same number of chemical workers.) But this is the first report of concrete progress.

One possible stumpling-block to eventual merger: inequality in the dues structure of the two groups. OCAW seeks to raise per capita tax to \$2.50/month; ICWU's rate is \$1.50/month.

Chemical companies can expect stepped-up union activity even before final merger plans are put to a vote next year. ICWU and OCAW plan to coperate now on company-wide councils organization and educational programs.

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for industry



1000 KW COMBUSTION GAS TURBINE GENERATING SET

Advanced design concepts are used at GDI to manufacture industrial turbomachinery ranging from cryogenic to prime mover applications.

Take the new gas turbine shown above. Design emphasizes simplicity, ruggedness, long life and favorable specific fuel consumption.

The Gas Producer section consists of a centrifugal compressor driven by an axial turbine on a common shaft. The Power Turbine is on a free shaft.

Fired with distillate oil or natural gas, this unit produces up to 1500 shaft hp. Hot components are air cooled. No cooling water is required for the unit itself.

Reduction gearing is available to match various loads such as generators and compressors.

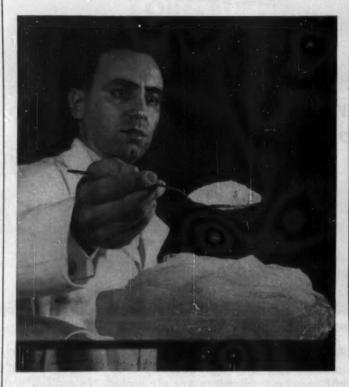
Service is accomplished on a sub-assembly basis, i.e., Gas Producer, Power Turbine and Combustor. Minimum handling equipment is required.

## GAS DYNAMICS

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## CHEMICAL PRODUCTS EDITED BY FRANCES ARNE



#### New Vinyl Polymer Powder Plus Water: Instant Jelly

Described as the most versatile agent ever discovered for thickening, suspending, dispersing and emulsifying, a new water soluble vinyl polymer is now in production at a brand new \$3-million plant at Calvert City, Ky., with a 70,000-lb./mo. capacity.

Called Carbopol, it has un-

usual uniformity and is compatible with fluids ranging from tap water to champagne. Applications are expected in the cosmetic, pharmaceutical, paint, printing, and food industries in products ranging from toothpaste to asphalt.—B. F. Goodrich Chemical Co., Cleveland, Ohio

#### Polyester Fiber

Extends range of wash-and wear apparel.

Eastman Kodak believes that its first entry into the polyester fiber field significantly extends the range of fabrics and apparel that can be classed as washand-wear or easy care.

Garments made of the fiber, blended in proper proportions with other fibers, have demonstrated a remarkable resistance to wrinkling. The fiber can be fabricated on all three standard spinning systems and on conventional production and dyeing equipment.

Called Kodel, the product is already in commercial production at Tennessee Eastman's Kingsport, Tenn., plant, which also produces acetate and acrylic fibers.

Other unique characteristics of the new fiber: outstanding resistance to pilling; high resistance to heat (it can be safely ironed at temperatures to 425 F.); great covering power and natural whiteness. It is thus far available in staple form only.

Prices for Kodel staple in 1½ denier/filament will be \$1.60/lb. and in 3 denier and 4½ deniers/filament will be \$1.50/lb.—Eastman Chemical Products, Inc., Kingsport, Tenn. 82B

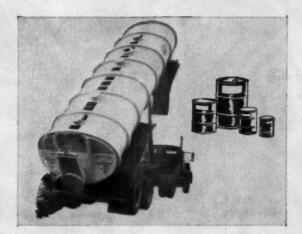
#### Polyester Plastie

Withstands 500 F. sustained, 1,000 F. for short periods.

Commercial production of a polyester plastic resin with about twice the heat resistance of previous polyesters has started. Called Vibrin 136A, it will withstand a sustained temperature of 500 F. and a peak load of 1,000 F. for short periods.

High mechanical strength when exposed to elevated temperatures together with exceptionally good high-frequency electrical properties suggest the material for radomes and nose cone housing for radar equipment on manned or unmanned aircraft. It is already in limited use as a radome material in jet bombing planes. Its use will probably continue to be limited, because of price, to cases of real need for its special combination of properties.

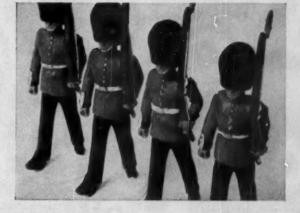
Chemically, the compound is described as triallyl eyanurate copolymerized with suitably designed polyester alkyds.—U. S. Rubber Co., New York. 82C



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#### Hydraulie Fluid

New compound, left, remains fluid at 700 F. Other fluid crystallizes.

A new synthetic fluid, an alkyl silane, holds promise as a hydraulic fluid for use in systems subjected to temperature and environmental extremes including those associated with high performance aircraft and missiles.

Designated QF-6-7009 Fluid, this new material is diphenyldidodecylsilane. It has better lubricating properties than most previously available high temperature fluids. It is thermally stable in closed systems over the wide range off -25 F. to 550 F. for long periods; up to 700 F. for short times.

Photograph above shows results of test to demonstrate thermal stability in a sealed hydraulic system. Fluid was sealed in an inert atmosphere within a thick-walled glass tube, then inserted in a heavy metal container and placed in a 700 F. oven. After ten hours the test was terminated. QF-6-7009 was virtually unaffected. Similarly packaged control fluids, one a silicate hydraulic base fluid (shown above), the other a diester turbine oil base fluid, exploded in less than four hours and were poured from their metal containers as crystalline residue.

In addition to its use as a hydraulic fluid, the new compound shows promise as a base oil in high temperature turbine lubricants, when formulated with suitable viscosity index improvers, antioxidants and other additives. Base fluids for high temperature greases offer another application possibility.

Now available in limited quantities, it represents the first commercial availability of diphenyldidodecylsilane fluid.—
Dow Corning Corp., Midland, Mich. 84A

#### Beryllium Oxide

Hot pressed and machined shapes for nuclear, aircraft, missile field.

Beryllium oxide's characteristics-low neutron capture crosssection, high thermal conductivity, high electrical resistivity and dielectric strength-has led this manufacturer to install facilities for the production of large, high purity shapes. They are adjacent to the company's main plant at Reading, Pa. Since beryllium oxide is an intermediate chemical in the production of the metal and beryllium alloys, starting material for the new shapes is withdrawn from the plant production flow.

One of the most promising applications of the new shapes is in advanced nuclear reactors where temperatures preclude the use of many present-day reactor materials. With a melting point of 4,658 F., beryllium oxide retains good tensile and compressive strength, high hardness and high modulus of elasticity at temperatures up to 3,500 F.—well above the ranges where most high temperature reactors will operate. The shapes are suitable for use as moderator or reflector, and beryllium oxide powder is an important component in ceramic fuel elements.-The Beryllium Corp., Reading, Pa.

#### **PVC** Compounds

#### Extrusion speed is doubled.

Two new rigid polyvinyl chloride plastics, QGD-5020 for high impact and QGD-5010 for extreme chemical resistance, can be extruded twice as fast as conventional rigid polyvinyl chloride compounds. They were engineered particularly for pipe and contour extrusion applications.

Both compounds are available in commercial quantities and are competitively prices at 42½ ¢/lb. in truckload lots.

On slightly modified commercial equipment they have run as high as 100% faster than competitive rigid polyvinyl chloride compounds and maintain better

surface smoothness. Good gloss characteristics can also be obtained on contours and sheet for vacuum forming. The National Sanitation Foundation lists these materials as suitable for making pipe that will carry drinking water.—Bakelite Co., New York, N. Y. 84C

#### BRIEFS

Indene is for the first time available in pure form in semi-commercial quantities. A bicyclic aromatic ring compound, it has the general properties of benzene with an unsaturated side chain and thus adds halogens and halogen acids.—Neville Chemical Co., Pittsburgh, Pa. 84D

Faster setting and more rigid than other types of Nylon 6 materials, the first of special Bayer type nylon molding materials under the company's license agreement with Fabenfabriken Bayer is now in production in New Hampshire plant. Called Fosta Nylon 62 ASK, it is a finely crystalline molding powder.—Foster Grant, Leominster, Mass. 84E

Three fungicides designed to lengthen service life of fabric and cordage by adding increased fungus resistance to natural fibers are now available: Fungitrol 25, 50, 100.—Heyden Newport Chemical Corp., New York, N. Y. 84F

Low static styrenes which can be injection molded into products having virtually no attraction for dust particles have been developed. They're called Lustrex Lo-Stat.— Monsanto Chemical Co., Springfield, Mass. 84G

#### For More Information . . .

about any item in this department, circle its code number on the

Reader Service postcard (p. 217)



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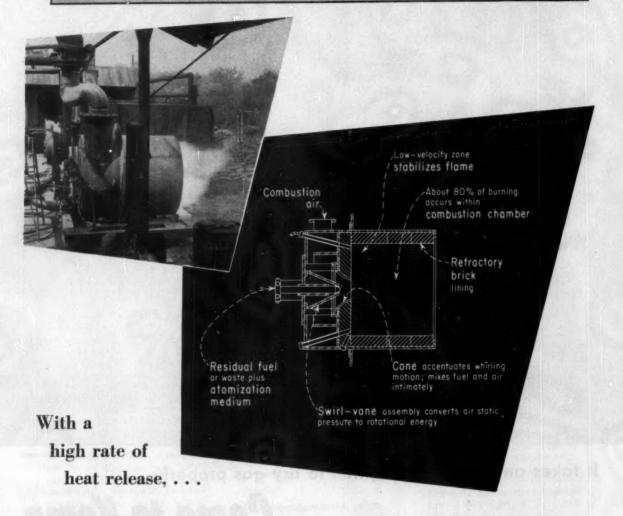






DEVELOPMENTS . . .

## PROCESS EQUIPMENT EDITED BY C. C. VAN SOYE



## **Burner Consumes Wastes and Residual Fuels**

An important advance in the field of industrial heating, new heavy-fuel combustion units produce upwards of a million Btu./(hr.) (cu.ft.).

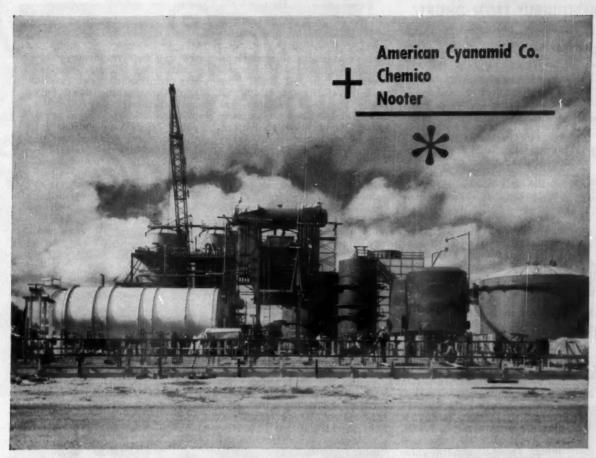
Back in February of 1953, we published an article describing the Thermal high-velocity burner, a unique equipment item featuring heat release rates on distillate or gaseous fuels of 1-10 million Btu./(hr.) (cu.ft.). Thermal Research & Engineering Corp., manufacturer of the unit, informed us at that time of their active ef-

forts to secure a suitable design for operation on heavy residual fuels and waste products. Such a unit—the Thermal Vortex burner—is now available.

Vortex burners operate on a wide range of fuels including Bunker C, No. 6, asphalts, short residuum, acid sludges, solvents or any gas. Fuel

switching without shutdown is commonplace; simultaneous firing of oil and gas is possible. Heat release rates vary from 1,000,000 Btu./(hr.) (cu.ft.) on No. 6 fuel, to about 3,000,000 for gases or light oils; in comparison, release rates for conventional burners run from 50,000 to 400,000.

Combustion is efficient, compact, rapid and clean. Conventional levels of fuel and air pressure are standard (140 psig. oil, less than 1 psig. air). Normal use requires 5% excess air; however, the system is



## \*they all add up to on-time performance for this triple superphosphate plant!

When American Cyanamid Company decided to expand its facilities for the manufacture of triple superphosphate, it looked to Brewster, Florida, for the plant site, and to the Chemical Construction Corporation for the designing and building of a new fertilizer plant.

It is significant that Chemico, in turn, called in the Nooter Corporation to custom fabricate and field erect all the tanks and processing vessels for the sulfuric acid facilities of this "fertilizer factory". Through past association, Chemico has learned to depend on Nooter skills for several important reasons:

(1) Years of specialized experience in the field of custom fabrication enabled Nooter to offer many time- and dollar-saving suggestions both before and during the plant installation.

(2) Nooter's extensive experience in field erection meant top assurance of on-time deliveries. (3) The quality of Nooter workmanship is known and respected from coast to coast. This fact, plus Nooter's competitive price, made them the natural choice for the job.

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capable of accepting an air input of from 70 to 300% of stoichiometric quantities—with no resultant soot or flameout.

The Lummus Co., which basically designed the Vortex burner, licensed world-wide rights to Thermal in 1956, Picking up the ball, Thermal introduced a number of improvements and modifications, and put the unit on the market in late 1957. Since then, about a dozen-and-a-half installations have been completed, some sold separately and some as integral parts of Thermal's line of heat equipment. All are claimed to be yielding extremely promising results.

Many Applications—Expectations are that many of the Vortex burners produced will find application in Thermal's own line of heating equipment. At present, two packaged items of the line utilizing the burner are available: a direct-fired air heater and a waste incineration system.

Designed to complement the burner's characteristics, the air heaters are extremely compact, and incorporate no refractory lining. These economical characteristics are directly attributable to the burner's high heat release rate. Nearly all combustion occurs within the burner; flames extend beyond its mouth for only a foot or two. In typical installations at Bartlett, Calif., Columbia-Southern is using two of the air heaters—one for drying, and one as part of a calcining operation.

As an incinerator of waste products, the burner also appears to have a bright future. These systems vary somewhat in design, depending on end use. A typical installation at General Chemical's Linden, N. J. plant is firing No. 6 fuel oil to incinerate waste fumes.

Development work on adaptation of the burners to other packaged products, such as inert-gas generators, submerged combustion concentrators, and fired heat exchangers, is now underway.

Vortex burners will also prove useful as integral parts of equipment lines not manufactured by Thermal. For instance, in Dowtherm vaporizers, the short flame characteristic minimizes the tube-overheating problems. In oil stills, the flame's velocity (about 100 ft./sec.) improves convection heat transfer by stirring up furnace gases. And in steam generators, the burner's low excess-air requirements result in improved efficiency.

Essentially, the Vortex burner consists of an air plenum chamber, swirl-vane assembly, burner barrel, controls and refractory-lined combustion cylinder. No external combustion chamber or furnace is required.

In operation, the static head of combustion air entering the plenum chamber converts to high rotational energy through the swirl vanes. This energy provides very intimate mixing of air and atomized fuel. The squared-off, rear circumference of the combustion cylinder induces small areas of low-velocity gas flow-these areas stabilize the flame. About 80% of the combustion occurs within the burner, leaving only a very short, whirling, hot (3,000 F.) flame protruding from the cylinder's mouth.

Models and Capacities—Six standard burner models are available, ranging in capacity from 3.5-48 million Btu./hr. Each model includes a gaselectric igniter and provision for a flame-failure safeguard of the scanner type. Fuel turndown on residual oil is 3:1 with pressure atomization and 5:1 with steam atomization. On gas, turndown is 6:1.—Thermal Research & Engineering Corp., Conshohocken, Pa. 86A

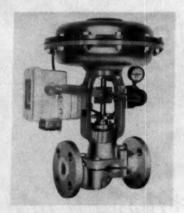
#### Linear Accelerator

Large-scale radiation processing at \$1.36/kw.-hr.

Offered as an economical and reliable source of ionizing radiation for large-scale processing, a new 10-million-volt, 21-kw. linear accelerator claims an operating cost of \$1.36/kw.-hr. based on 8,000 hr./yr. utilization. Quoted operating price for two such units operating together is only \$1.02/kw.-hr.

Known as the Mark 20-521,

the unit features demountable construction. Thus, preventative maintenance crews have to shut the machine down only until spare sections replace the principal sections requiring repair. Typical applications for the accelerator include crosslinking of polymers, sterilization or pasteurization of foods, and curing of solid rocket propellants. Capacity in terms of a typical polymer cross-linking operation by electron radiation 7-million lb./yr.—Applied Radiation Corp., Walnut Creek,



#### Control Valve

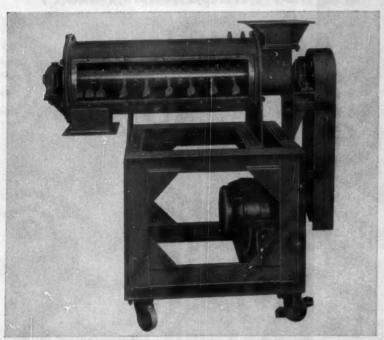
Ideal for high-pressure drops, flashing service.

Claimed by the manufacturer to be a new design concept, the Type 1000 control valve features a springless diaphragm motor operator that requires less air pressure for operation, yet transmits greater force to the valve stem. Single-seat construction streamlines the flow and eliminates erratic pressure variations. Pressure losses concentrate at the flow area, thus assuring maximum flow rangeability.

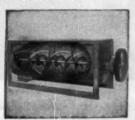
Materials of construction include steel, stainless, Monel and Hastelloy C; diaphragms are made of Buna-N-Nylon. Sizes offered range from 1 to 6 in. for all materials.—Uniflow Valve Corp., Cranford, N. J. 88B

Nitrogen Generator and other equipment news on page 198.

# NEW HIGH SPEED MIXER FOR QUALITY FINISHING



The Turbulizer produces a homogeneous mix, increases production while reducing mixing time and costs.



TRIPLE ACTION MIXER - Complete uniform blending in 2 to 7 minutes.

STRONG-SCOTT TRIPLE ACTION MIXER exposes each particle in the mixture to over 10,000 separate mixing actions per minute as it blends and folds. This produces a uniformly mixed product with 99.9% thorough distribution of minor additives.



TWIN ROTOR MIXERS—Accurate blending of liquids and dry mix at any speed.

TWIN ROTOR MIXERS are designed primarily for high percentages of liquid application to light weight ingredients, where product identity is to be maintained. A double shaft assembly with overlapping, adjustable paddles gently combine the liquids with the dry mix.

#### STRONG-SCOTT TURBULIZER

Provides Fast, Thorough Dispersion, Disintegration and Blending of Dry Materials, or Pastes Involving Liquids and Solids.

The Turbulizer is a high speed, continuous mixer that will disintegrate and disperse fat pellets, chemical ingredients which have a tendency to ball or agglomerate, and other ingredients which can be broken by the paddles and thoroughly dispersed in the mixture. Product uniformity is accurately maintained as a result of high speed centrifugal forces created by the paddles.

It is also highly applicable where a fluffing action is desired on powdered material. Minor percentages of liquid may easily be added to dry mix with high efficiency and dispersion results.

The Turbulizer is self cleaning and is built with sanitary seals at each end of the shaft. The interior is precision machined. Overlapping, adjustable paddles turn within a close tolerance to the chamber wall, providing a selective rate of material flo

The TURBULIZER may be furnished in carbon or stainless steel and may be jacketed for hot water, steam or a refrigerant. Capacities will vary depending on the bulk density of the material and the degree of agglomerates encountered. Consult Strong-Scott for full details.

SEE OUR COMPLETE LINE OF EQUIPMENT IN THE 1959 CEC PAGES 1675-1678



WRITE FOR FREE COLOR BULLETIN

For complete information on the equipment shown above, write to The Strong-Scott Mfg. Co. The Strong Scott

Mfg. Co

DEPT. CE-630

Equipment Designed for Better Processing
451 TAFF STREET, MINNEAPOUS 13, MINNESOTA



MINIMUM MAINTENANCE, LONG LIFE ASSURED BY THESE HEAVY-DUTY

"Buffalo" Type "Bl" Fan
For Classes I & II Service

The high performance characteristics of these two outstanding "Buffalo" Fans has resulted in their wide-spread use in the field of industrial air handling. In addition to offering peak-efficiency operation in their respective classes, both the "BL" and the "BLH" bring you a bonus economy factor of maintenance reduced to an absolute minimum throughout a long, productive life. This minimum maintenance factor is directly due to unusually rugged "Buffalo" construction features such as:

HOUSINGS—The heavy gauge sides and scroll are of all-welded construction. Heavy structural steel bracing provides housing stiffness and rigid bearing support. Flanged inlets and outlets give added support.

**SHAFTS**—Hot-rolled or forged shafts are ground to close tolerances for perfect wheel and bearing fit.

WHEELS—Sturdy backward-curved blades are welded to the die-formed shroud and welded or riveted to the solid

backplate. Heavy hubs assure permanent shaft alignment. For higher tip speeds, reinforcing rings provide necessary wheel rigidity.

**BEARINGS** — Self-aligning anti-friction bearings are designed for continuous operation at maximum tip speed. Horizontally split, ring-oiled, self-aligning, babbitted sleeve bearings are also available.

For full details, contact your "Buffalo" representative, or write for Bulletins F-102 and F-200.

Minimum maintenance is assured by the famous "Q" Factor — the built-in QUALITY that provides trouble-free satisfaction and long life in every "Buffalo" product.



#### BUFFALO FORGE COMPANY

501 Broadway • Buffalo, N. Y.
BUFFALO PUMPS DIVISION, BUFFALO, N. Y.

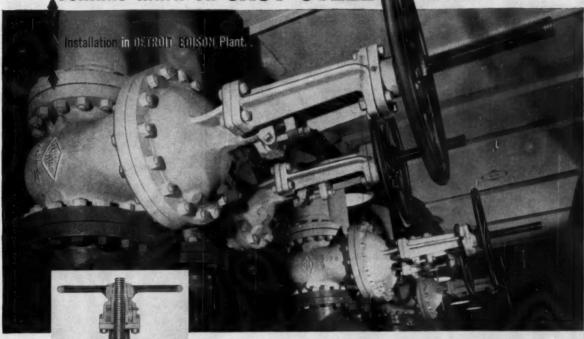
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Canadian Blower & Forge Co., Lia., Kitcoener, Ont.

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

## where they really know Costs

-you'll likely see the famous Jenkins mark on CAST STEEL



In the power generation and industrial processing plants where Cast Steel valves are numbered by the score . . . where replacement and maintenance costs are recorded to the last penny . . . the true economy of Jenkins Valves is clearly seen.

Records will always show the extra value which Jenkins builds into Cast Steel valves, not only with design features you can see but also with unbending quality standards for alloys, castings, machining. Plus the toughest known testing and inspection system to assure perfection in every detail, and safety factors far beyond ratings.

Select from the Big Line in this Catalog. It includes pressure castings of Carbon, Carbon-Moly, 11/4 % Chromium-Moly, 4% - 6% Chromium-Moly, 31/2% Nickel . . . alloys that meet a wide variety of specifications. Also, a wide choice of patterns, sizes and seating material combinations to satisfy your different service conditions.

CALL YOUR JENKINS DISTRIBUTOR for a copy of Jenkins Cast Steel Valve Catalog and prices. Or write to Jenkins Bros., 100 Park Ave., New York 17.

#### Typical Jenkins features deliver lasting economy

Fig. 1046 600 lb. 0.S. & Y. Globe

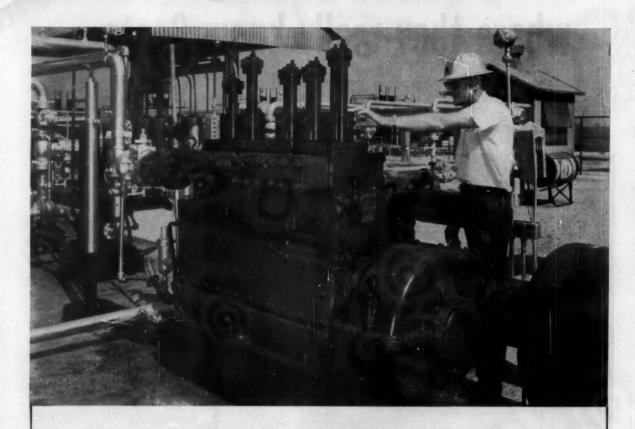
A ball bearing yoke sleeve is standard on larger sizes \* Cooling chamber and plugged connection for test purposes is regularly provided below packing box, but a lantern gland stuffing box is optional \* Rustproof, lubricated and graphited, wire reinforced packing is standard \* Soft steel ring joint body-bonnet gasket, fitted into accurately matched grooves to assure a vapor-tight joint \* Seating is regrind-renew type.







Sold Through Leading Distributors Everywhere



#### FIELD REPORT

SERVICE: LP-Gas Injection

Burnell-North Pettus Cycling Plant

PUMP: 11/2"x5" Aldrich Quintuplex

OPERATION STARTED: June, 1950

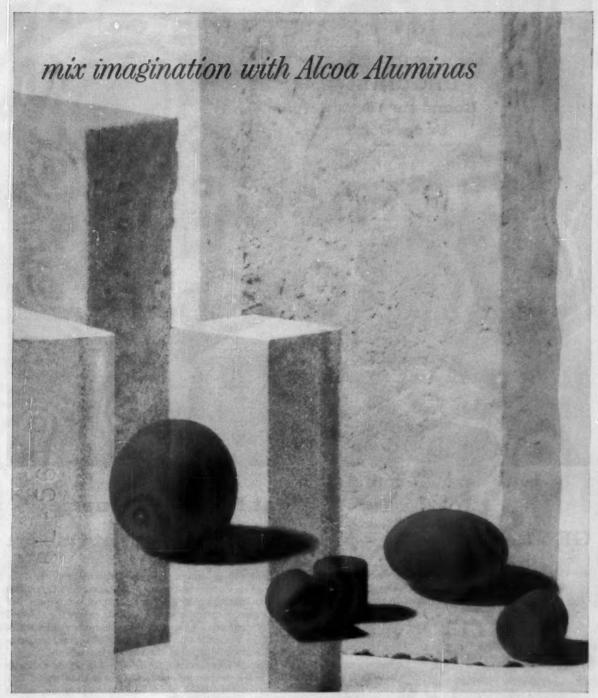
EXPERIENCE TO DATE:

Continuous service...pump delivers 52 gpm at 3000 psi. Routine maintenance annually...plungers are repacked as necessary. Customer reports: "complete satisfaction" with the performance of the Aldrich pump.

Field parts stock available in Carmi, Ill.; Calgary; Casper, Wyoming; Charleston, W. Va.; Houston; Los Angeles; Odessa and Tulsa. For further information, write the Aldrich Pump Company, 3 Gordon Street, Allentown, Pa.

the toughest pumping problems go to





to beef up these backbones of industry: Few industries could prosper without high performance ceramic refractories, mill liners and grinding media. They are the backbones of industry... and they will serve best, serve longest when imaginative engineering puts Alcoa® Aluminas in their composition. These pure aluminum oxides increase refractoriness in direct proportion to the amount used... they increase stability and strength under load at high temperatures... improve resistance to thermal and structural spalling or deformation

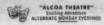
at high temperature . . . . minimize corrosion and erosion. Small wonder that users and makers of refractory shapes and castables, ceramic grinding media and mill liners have found it pays to mix imagination and engineering with Alcoa Aluminas . . . . for top performance at reasonable cost.

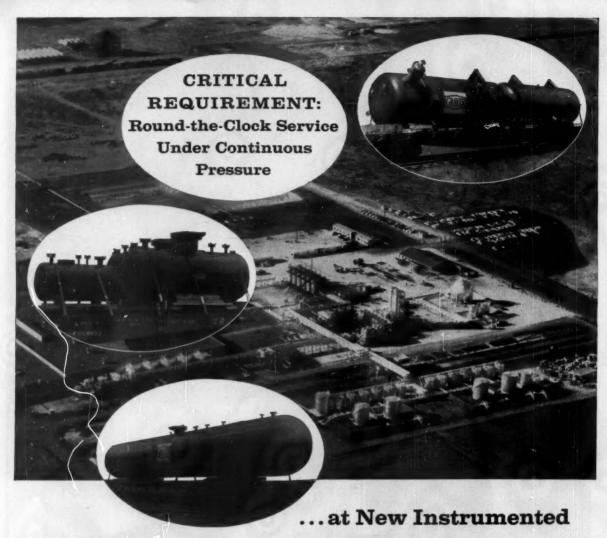
and engineering with Alcoa Aluminas . . . for top performance at reasonable cost.

Alcoa does not manufacture refractories, mill liners or grinding media. We do supply aluminas to makers of the best of these products. For their names, write Aluminum Company of America, Chemicals Division, 702-K Alcoa Building, Pittsburgh 19, Pennsylvania.

For finer products . . . let Alcoa add new dimension to your creative thinking!







## **GENERAL TIRE Synthetic Rubber Plant at Odessa**

The nation's first privately financed and first completely integrated synthetic rubber operation owned jointly by The General Tire & Rubber Company and The El Paso Natural Gas Company at Odessa, Texas utilizes 880 instruments for absolute and continuous control by a single operator.

Just 22 months after the agreement was signed between The General Tire & Rubber Company and The El Paso Natural Gas Company, two new plants costing \$32,000,000 went on stream at Odessa, Texas to manufacture GR-S synthetic rubber. Now in full production day and night, a continuous stream of raw materials enters the General Tire plant at one end, leaving the other end as bales of synthetic rubber. The entire manufacturing process demands the utmost care in the control of timing, temperatures, pressures and the proportionate quantities of the various ingredients.

Eighteen pressure vessels fabricated by Graver of ASTM A-285 Grade C flange quality steel are important links in the modern automation chain at the General Tire plant. Built to be in operation around-the-clock under continuous pressure, the 18 pressure vessels are symbolic of the meticulous fabricating craftsmanship Graver applies to processing equipment for the petrochemical, chemical and petroleum industries. Over a century of experience qualifies Graver to tackle the most exacting specifications.

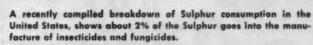


Building for the Future on a Century of Craftsmanship in Steels and Alloys

#### GRAVER TANK & MFG. CO., INC.

EAST CHICAGO, INDIANA • New York • Philadelphia Edge Moor, Delaware • Pittsburgh • Atlanta • Detroit • Chicago Tulsa • Sand Springs, Oklahoma • Houston • New Orleans Los Angeles • Fontana, California • San Francisco





Not much, perhaps, as tonnages go but no other use of Sulphur is more important with the possible exception of the 'wonder' drugs. It doesn't

take much imagination to picture what would happen if the bugs and parasites were allowed to take over our crops and trees. Sulphur, along with other chemicals, is helping to protect our food supplies and foliage.

The role that TGS is playing in this constant fight against crop destruction is to see to it that the manufacturers of the insecticides and fungicides always have a ready supply of Sulphur, both solid and molten. This constant production and centralized distribution coupled with technical help is our contribution to industry.

#### SULPHUR PRODUCING UNITS

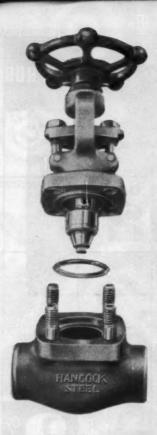
- Newgulf, Texas Spindletop, Texas
- · Moss Bluff, Texas · Worland, Wyoming

· Fannett, Texas



#### TEXAS GULF SULPHUR CO.

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## **NEW VALVE-OLOGY**

#### shuts off costly maintenance

Hancock 600# Steel Valves incorporate new concepts in valve-ology that reduce valve maintenance and equipment down-time. The forged steel bonnet and body have butting flanges so strong no distortion is possible. The flanges form a bonnet joint that utilizes the sealing power of a Flexitallic\* gasket so effectively not even pressures exceeding ten times the rating of the valve can cause a blowout.

Hancock valve-ology makes full use of stainless steel to reduce your valving cost. Seat, disc, stem, swing bolts and nuts, thread bushing, packing gland follower—all are stainless steel. Globe, Angle, "Flocontrol", Lift Check, and Hi-Pressure Drop designs available. A high degree of standardization simplifies servicing and inventory needs. Your industrial supply distributor will gladly give you full details on Hancock Valve quality and performance. Phone him today.



Hancock 600 # Steel Globe Valve. Type 5500 Line. Sizes: 1/4" thru 2".

\*Trademark of Flexitallic Gasket Company



#### HANCOCK STEEL VALVES

MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Watertown, Massachusetts In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

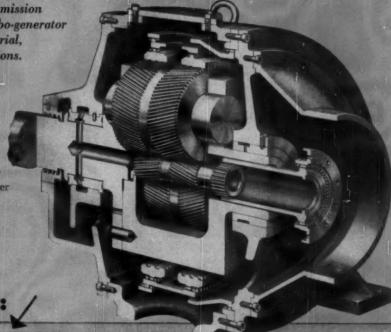
## DE LAVAL-STOECKICHT PLANETARY GEAR

## ...for high speeds...high horsepower

Proved in hundreds of installations abroad totalling over 3,000,000 horsepower-now available in America!

For all high torque power transmission applications such as pump turbo-generator and compressor drives in industrial, municipal and marine installations.

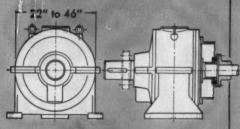
This cutaway view of the De Laval-Stoeckicht Planetary Gear shows how it provides flexibility for proper load distribution throughout the gear members. The thoroughly proved and tested design is completely reliable in transmitting high horsepower for high speed applications. • Highest efficiencies (98% or higher) ... no high speed bearings...less friction losses.



### Check These Advantages:

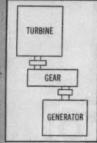
#### Small Size - Light Weight

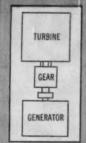
Compact—low weight per hp. Sizes range from 22" to 46" in diameter, depending on horsepower requirements. Example: 5000 hp planetary unit weighs 1700 lbs. against 6000 lbs. for conventional gear.



#### **Convenient Arrangement**

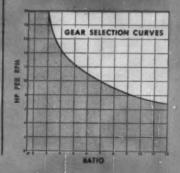
Co-axial or "in-line" arrangement of gear members takes up far less space than parallel axis gears of equivalent horsepower rating.

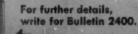




#### Wide Application

Capacity range shown in shaded area on chart below. For other applications, contact your De Laval Sales Engineer.









DE LAVAL Steam Turbine Company

803 Nottingham Way, Trenton 2, New Jersey

## HOW HERCULES HELPS...



PROTECT THE "FROG POND"—This landmark on Boston's historic Common must be kept clean and fresh-looking all year round. "Ramuc" Enamel, a Parlon\* (chlorinated rubber) based paint designed for constant submersion in water does the job efficiently. Manufactured by Inertol Co., Inc., Newark, N. J., the paint was last applied in May, 1957. The pool is now well along in its second year, with no repainting indicated.



IMPROVE EXISTING PRODUCTS—The cap and valve of this garden hose spray gun are molded with Pro-fax\*, Hercules' exciting new polypropylene. Tough, durable, lightweight, and low in cost, Pro-fax is now providing many new and improved products in fields previously served by metal, wood, or glass.



PRESERVE THE PRINTED WORD—Billboard posters are now being protected with a coating based on EHEC, Hercules® ethyl hydroxyethyl cellulose. EHEC lacquers won't bleed the inks and yet protect the posters against extremes of weather. Its solvency in low-solvent solutions makes EHEC ideal as a film-former in numerous formulations.

#### HERCULES POWDER COMPANY

900 Market Street, Wilmington 99, Delaware

CHEMICAL MATERIALS FOR INDUSTRY





A clad "sandwich" being assembled prior to hot rolling. Claymont Stainless-Clad Plates—5 to 50% stainless inseparably bonded to carbon steel backing—offer the corrosion and abrasion protection of stainless steel plus the economy of carbon steel. This is another of the many steel plate products available from Claymont's integrated mill.

by d'Arazien

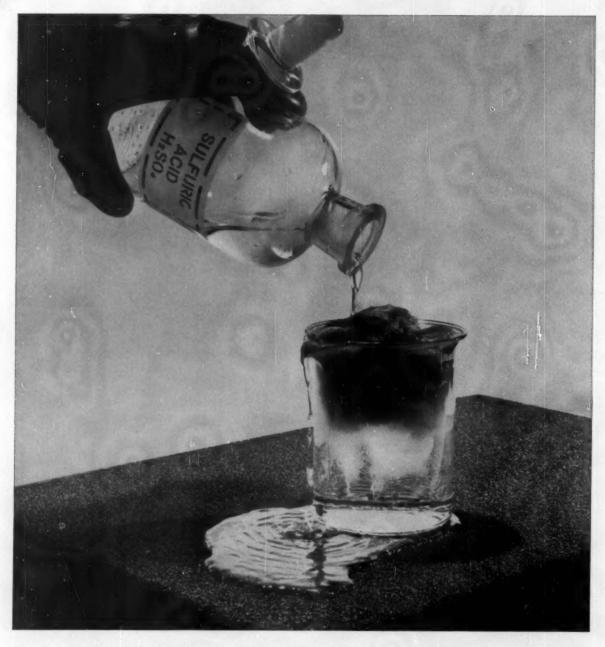
## CLAYMONT STAINLESS-CLAD PLATES



CHECK CLAYMONT FOR—Alloy Steel Plates • Carbon Steel Plates • Stainless-Clad Steel Plates
High Strength Low Alloy Steel Plates • CF&I Lectro-Clad Nickel Plated Steel Plates • Pressed
and Spun Steel Heads • Manhole Fittings and Covers • Fabricated Steel Products
Large Diameter Welded Steel Pipe

PRODUCTS OF WICKWIRE SPENCER STEEL DIVISION • THE COLORADO FUEL AND IRON CORPORATION
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... always an insulation investment; never an insulating expense

## FOAMGLAS® IS ACID-PROOF

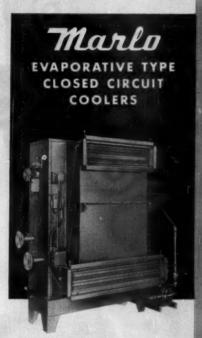
Few insulations are acid-proof... and there's a lot of acid around a chemical processing operation. It spills or leaks from piping and equipment, and there's often plenty of it in the atmosphere. That's why most insulations break down so fast in these surroundings. Not FOAMGLAS! This unique insulation is made entirely of glass. Like all glass, it's acid-proof. There's far more to this insulation investment story. FOAMGLAS is waterproof and vapor-proof. That means its insulating value never changes. It's dimensionally stable ... can't burn ... unusually strong ... easy, economical to handle and install. Let all these benefits make FOAMGLAS a valuable insulation investment on your piping and equipment. Write for our latest Industrial Insulation Catalog. PC Glass Blocks are another outstanding building product of Pittsburgh Corning Corporation.

#### PITTSBURGH CORNING CORPORATION

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## NOW...available in special corrosion-resistant

## STAINLESS STEEL ALLOYS



To cool fluids, condense gases, dissipate waste heat.

Modulating controls avail-

## Marlo

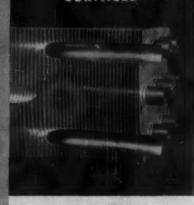
COOLING TOWERS



Suitable for indoor or outdoor installation. Compact in design, quiet operating. All metal construction. Controls for winter operation.

## Marlo

HEAT TRANSFER SURFACES



To heat and cool fluids, condense gases, evaporate liquids. Also available in any combination of commercial metals and alloys.

## for rugged, dependable process service...

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Please send me information on Marlo equipment checked

Cooling Towers

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Please have representative call

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WEIGHING ...



## Fairbanks-Morse Scales Offer New Economy, Accuracy, Speed...Electronically!





Read-out to auto-





Sequence batcher anual programn



Punch card operated

## **Even Adapts to Present Mechanical Systems**

Fairbanks-Morse electronic control and instrumentation permits remote location of weight recording instruments...assures automatic balance detection...automatic ranging without drop-weights...automatic zeroing...pushbutton recording and much more.

This same electronic control of weight measurement can be employed to streamline your batching operation. You can select precise quantities of all materials...in proper sequence...at the push of a button. Or you can put the batching formula on a punch card and do the whole job automatically.

Weight readings can be fed to automatic typewriters, adding machines, tape punchers, etc. Chances are your present lever system can be converted to electronic operation.

For more information write today for new literature. Fairbanks, Morse & Co., 600 S. Michigan Avenue, Chicago 5, Illinois.



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a name worth remembering when you want the BEST

SCALES . PUMPS . DIESEL LOCOMOTIVES AND ENGINES . ELECTRICAL MACHINERY . RAIL CARS . HOME WATER SERVICE EQUIPMENT . MAGNETOS

## WILLIAMS ROLLER MILLS

• Quality Fine Grinding... 20 Mesh To 400 Mesh ... Micron Sizes On Some Materials

#### EXCLUSIVE GEARLESS AND SPUR GEAR DRIVES

Another Williams advancement! Cutaway shows Type
D Mill with Spinner Air Separator with spur gear and
pinion drive used on Standard and larger models.
Smaller sizes have simple gearless V-belt drive which
is easier to maintain than beyel gear drive—cuts
labor and downtime.

Bearing alignment of central shaft is simplified with only 2 bearings, the bottom one carrying thrust as well as radical load.

NOTE FLOW OF MATERIAL being ground by rolls rotating against bull ring, then air-swept to separator which discharges finished product while returning coarse tailings for regrinding.

From raw material to finished product—completely automatic grinding, blending and precision classifying to 20 mesh or micron size!

Self-adjusting feed rate . . . instant adjustment for sizing, even while mill is in motion . . . continuous automatic take-up to compensate for wear . . . constant rising air current to prevent build-up of fines and inefficient operation . . . automatically controlled hot-air drying durall are features of Williams Roller Mills that virtually guarantee increased output, surprising cost reductions and exceptionally high uniform quality. Get all the facts immediately... Write today for catalog.

WILLIAMS PATENT CRUSHER & PULVERIZER CO.



2706 N. 9th St.

St. Louis 6, Mo. THE SHADE

Oldest and Largest Manufacturers of Hammer Mills in the World

CHEMICAL ENGINEERING-October 20, 1958



# **NEW BAILEY**Multi-Pointer Gage



## ...has twice as many indicators ...no taller than a telephone!

Now the popular versatile Bailey Multi-Pointer Gage has been reduced in size to conserve control panel space—without loss of easy readability.

Each new Multi-Pointer Gage Unit offers you these three choices to-

- Measure and indicate draft, pressure, differential pressure and level.
- 2. Transmit above variables either pneumatically or electrically to remote indicators, recorders and/or controllers.
- Receive and indicate any measured variables which may be transmitted pneumatically by standard SAMA ranges of 3-15 psig. or 3-27 psig.

#### FEATURES

Compact Size—Two large, easily-read 7" scales in space only 4 inches wide.

Wide Range Selection — Standard ranges from 0-0.5 in,  $\rm H_2O$  to 0-5000 psig available.

Choice of Standard Colors — Satin Black, Slate Gray, Moss Green, or Terra Tan may be selected as an exterior color at no additional cost.

Colored Scales - Scales available in white, red, green, blue, yellow, or orange.

Fluorescent Illumination — All gages have slideout unit containing bulb and starter for ease of maintenance.

Readily Accessible Adjustments — Zero adjustment made from front of gage. Other adjustments made from rear of gage.

Two-point Positive Mounting — Gage unit mounted with two clips . . . no holes to drill or stude to weld.

Unlimited Indications — Any number of basic two-indicator units may be placed side-by-side to provide indications of related factors. Each two-indicator unit is separately mounted.

For additional information, call your local Bailey District Office, or write us direct.

Chemical and petroleum division

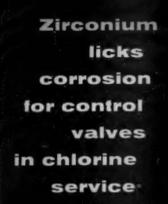
### BAILEY METER COMPANY

1054 IVANHOE ROAD

CLEVELAND 10, OHIO

In Canada-Balley Meter Company Limited, Montreal





Zirconium stems in process control valves are now being used in liquid chlorine service to eliminate costly downtime and maintenance expense caused by corrosion of conventional materials. Zirconium has demonstrated from 4 to 20 times longer life than type 316 stainless steel, and has proved superior to titanium and the high nickel and super alloys.

Engineers at Columbia-Southern Chemical Corporation, alert to corrosion-resistant possibilities of zirconium, tested it in actual operations for over two years.

Columbia-Southern has now standardized on zirconium stems, flanged packing glands, and hold-down nuts and bolts for all control valves in chlorine service.

Look at corrosion with zirconium in mind. Zirconium offers you the same opportunity to combat corrosion. Zirconium is now available in quantity and Columbia-National, through its technical service facilities and resources, will help you achieve economies in your processing operations by using zirconium to solve specific corrosion problems. Write for bulletin on properties and uses.

Valve stem above, of conventional stainless steel, failed after only six months, causing expensive downtime and maintenance.

This control valve with a zirconium stem continues to operate dependably after two years of service at the Columbia-Southern Plant at Natrium, West Virginia.

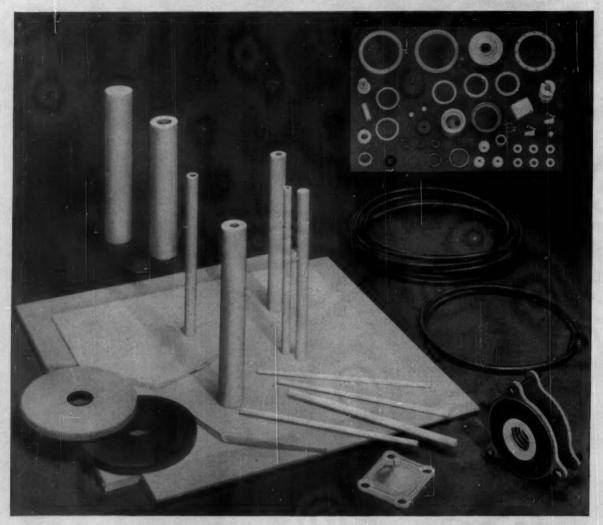
#### **Columbia-National Corporation**

Jointly owned by National Research Corporation and Columbia-Southern Chemical Corporation

DEPT. CS-D-70 MEMORIAL DRIVE, CAMBRIDGE 42, MASS.



# If you need TEFLON\* in <u>any</u> form R/M is the place to get it!



Raybestos-Manhattan pioneered in research and development in the use of "Teflon." R/M has had vast experience in fabricating this amazing substance . . . has accomplished things with it once thought impossible, such as molding highly complex valve diaphragms.

But R/M has more than the know-how—it has the facilities to produce "Teflon" in exactly the form you want it . . . can supply all your needs, from the usual types of

tubes, tape, rods, sheets and flexible wire braid covered hose to complicated molded and machined parts.

That is why R/M should be your headquarters for all your needs in products made of "Teflon," from simple standardized parts to intricate components painstakingly customized to your specifications. Call on your nearest R/M district office for the cooperation you need. Or write for detailed information.

\*A Du Pont trademark



## RAYBESTOS-MANHATTAN, INC.

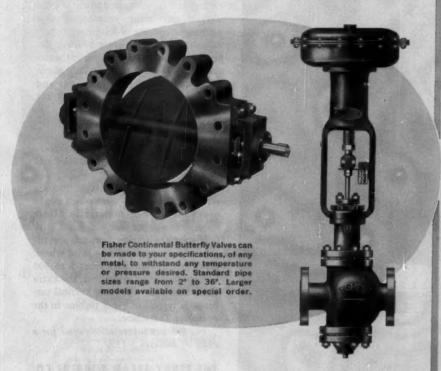
PLASTIC PRODUCTS DIVISION FACTORIES: MANHEIM, PA.; PARAMOUNT, CALIF.

Contact your nearest R/M district office listed below for more information or write to Plastic Products Division, Raybestos-Manhattan, inc., Manheim, Pa.
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NEW ORLEANS 17 • PASSAIC • PHILADELPHIA 3 • PITTSBURGH 22 • SAN FRANCISCO 5 • SEATTLE 4 • PETERBOROUGH, ONTARIO, CANADA

RAYBESTOS-MANHATTAN, INC., Engineered Plastics • Asbestos Textiles • Mechanical Packings • Industrial Rubber • Sintered Metal Products • Rubber Covered Equipment
Abrasive and Diamond Wheels • Brake Linings • Brake Blocks • Clutch Facings • Laundry Pads and Covers • Industrial Adhesives • Bowling Balls

# NOW FISHER GOVERNOR PLUS CONTINENTAL EQUIPMENT

### an addition that multiplies Fisher's service to industry



With the acquisition of Continental Equipment,
Fisher Governor Company is able to expand its service and
product offering to its customers.

Continental Butterfly Valves are now available through the Fisher representatives listed at right.



If it flows through pipe anywhere in the world ... chances are it's controlled by ..

### **FISHER GOVERNOR COMPANY**

Marshalltown, lowa / Woodstock, Ontario / London, England
CONTINENTAL EQUIPMENT CO. DIVISION, Coraopolis, Pennsylvania

### THESE FISHER REPRESENTATIVES CAN SUPPLY YOU WITH CONTINENTAL BUTTERFLY VALVES

AMARILLO Juson Supply Company ATLANTA BALTIMORE The Rhodes Controls Company BIRMINGHAM Joseph W. Eshelman & Company BUFFALO Company CALGABY-EDMONTON Berber Engineering & Supply Company CARACAS. VENEZUELA Sinclair Spence CHARLOTTE Robert E. Mason & Company CHICAGO General Meters & Controls Company CINCINNATI H. T. Porter Company A. E. Ehrke & Company DALLAS Vinson Supply Company Joy & Cox, Inc. DETROIT DuBois-Webb Company HOUSTON-CORPUS CHRISTI Puffer-Sweiven Company INDIANAPOLIS Acme Engineering Agency KANSAS CITY Sullivan-Mears Company LOS ANGELES B. R. Jones & Company LOUISVILLE Allan K. Cook Company MARSHALLTOWN R. S. Stover Company MEMPHIS Johnson & Scott MEXICO, D. F. Babcock & Wilcox de Mexico MILWAUKEE W. D. Ehrke & Company MONTREAL Process & Steam Specialties, Inc. NEW ORLEANS-LAFAYETTE John M. Carter Company John M. Carter Company
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SINCE 1880

### Here's a vertical turbine with

# TERRY SOLID WHEEL

### and all its advantages



When it comes to judging a turbine's ability to deliver in vertical service, ratings tell only half the story. It's the Terry construction refinements that give you assurance of long-range operational economy: Thrust bearing designed to absorb external pump thrusts ... carbon ring glands specially made for vertical operation ... casings and bearing housings split vertically for easy accessibility.

But most important, the Terry vertical turbine has an almost indestructible rotor. A single forging of special composition steel, it has no separate parts to loosen or work out. As the only function of the blades is to form a series of pockets, any wear which might occur would not materially affect horsepower or efficiency.

If your application demands a vertical turbine, specify Terry solid wheel. Available in capacities from 5 to 300 horsepower. And remember, the extra durability built into these vertical turbines is typical of every turbine in the complete Terry line.

For further information, send for a copy of bulletin S-137.

THE TERRY STEAM TURBINE CO. TERRY SQUARE, HARTFORD 1, CONN.





TT-1210

October 20, 1958—CHEMICAL ENGINEERING



# What can peroxygens— and BECCO—do for YOU?

### If you are concerned with ...

Bleaching textiles or pulp, wood or leathers
Modification of carbohydrates
Dye oxidation
Foam rubber
Epoxidation and organic synthesis
Polymerization and depolymerization
Surface disinfection
Metal surface treatment
Color film processing
Powder bleaches and household detergents
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... you'll find Becco's thirty years of experience in the production and practical application of peroxygen chemicals can help you in many phases of your operation. No other company can offer you the benefit of this amount of exclusive experience — yours without obligation!

For example, just drop us a line, and an experienced Becco technical representative will call on you at your convenience, to discuss any process to which peroxygen chemicals are applicable. In addition, our staff of chemists and engineers is at your service to assist in any development work necessary. Finally, over 80 informative technical bulletins have been prepared and are yours for the asking — write us for the complete list. At the same time, ask to have our publication, BECCO ECHO, mailed to you regularly — it contains a wealth of information on peroxygen compounds. Address:

### BECCO CHEMICAL DIVISION

Food Machinery and Chemical Corporation Station B, Buffalo 7, New York

# Progress in Peroxygens BECCO



FMC CHEMICALS INCLUDE: BECCO Peroxygen Chemicals • WESTVACO Phosphates, Barium and Magnesium Chemicals • WESTVACO Alkalis, Chlorinated Chemicals and Carbon Bisulfide • NIAGARA Insecticides, Fungicides and Industrial Sulphur • OHIO-APEX Plasticizers and Chemicals • FAIRFIELD Pesticide Compounds and Organic Chemicals



5 Basic Cylinder Designs Meet Every Pumping Requirement



Spring loaded packing



Packing adjusting screw style stuffing box



Poppet valve, stainless steel



Ball valve, hardened inserted valve seat



# Gaulin Horizontal Triplex Pumps Reduce Operating and Maintenance Costs in Large Volume High Pressure Pumping

Gaulin Triplex Pumps give you every advantage to increase pumping capacity . . . minimize operating, inspection and maintenance costs.

Horizontal Design provides well area separating product from crank case ... makes every part easy to get at for inspection or maintenance.

Well Area can be gasketed for maintaining sterility; inert compatible chemicals (gases or liquid) for hazardous materials.

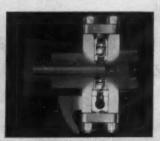
Goulin Cylinder can be disassembled in minutes . . . cuts maintenance costs to a minimum.

Corrosion-Proof. All product contacting parts are stainless steel.

Abrasion Resistant. Critical wear points available in abrasion resistant materials.

Gaulin Triplex Pumps are available in capacities from 50 to 6500 GPH... pressures from 500 to 12000 PSI... horsepower to 150 HP... operating temperature ranges from minus 90°F to plus 550°F.

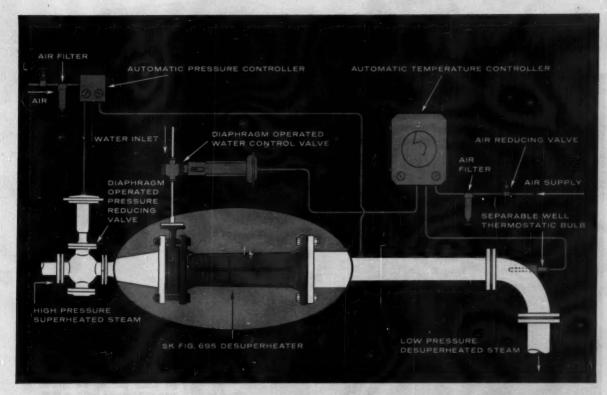
Thousands of installations with leading companies prove rugged, dependable Gaulin pumps provide long service at minimum cost in transfer, metering and spray drying applications. Write for Bulletin No. P-55.



Ball vaive, removable vaive seats



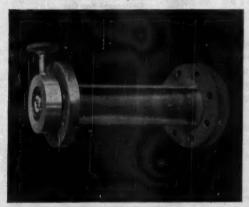
World's largest manufacturer of stainless steel reciprocating, positive displacement, pressure exchange pumps, dispersers, homogenizers and colloid mills.



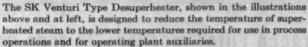
### **Reduce Steam Temperature for Process Operations**

### with this light, easily-controlled Desuperheater

SK Fig. 695 Venturi Type Desuperheater. An important feature of this desuperheater is the fact that the water need not be at higher pressure than the steam entering the desuperheater. As noted in description, right, water can enter the unit at inlet steam pressure.



RET APPARATUS: Rak für Condinazut Bulletin I-1,
ROTAMETERS & FLOW INDICATORS: Ask for Condensed Bulletin M-1,
VALVES: Ask for Condensed Bulletin V-1,
HEAT TRANSFER APPARATUS: Ask for Condensed Bulletin IIT-1,
GEAR PUMPS: Ask for Dubletin 17-A.



These Desuperheaters are light in weight and small in dimensions—are supported directly by the superheated steam line. In addition, they are simple in construction, provide straight-through flow with only a small pressure drop. Because these units are designed for application with automatic control, they are particularly well suited for process and petroleum plants where steam flow varies. They can, however, be used without controls where steam flow is steady. In such cases only a separator need be added.

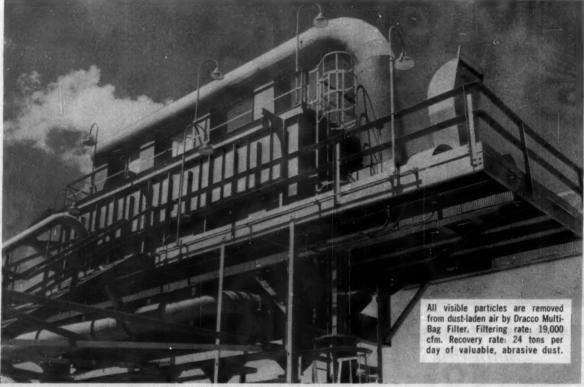
The Venturi Type Desuperheater reduces steam temperature by bringing water into contact with the superheated steam. The water pressure is low since it need only equal the operating steam pressure. The water is preheated in the chamber around the water diffuser and issues, through many small jets, into the steam stream. Since the steam-water mixture is discharged through the desuperheater outlet in a fog-like condition, without contacting the sidewalls, maximum desuperheating effectiveness is obtained and minimum wear occurs in the discharge piping.

The particular desuperheater shown is one of four types made by SK for process plants. Complete details on all types are contained in Bulletin 6D. Write for a copy.

# Schutte and Koerting

MANUFACTURING ENGINEERS SINCE 1876
2217 State Road, Cornwells Heights, Bucks County, Pa.

# Reynolds foils dust problem



### Consulting Engineer: Bechtel Corp.

### Dracco Filter recovers 24 tons per day of -44 micron alumina dust

Reynolds Metals Co. likes to keep its plants as clean as its rolls of shiny aluminum foil. So they installed Dracco Dust Control Equipment at their Sherwin Plant, Corpus Christi, Texas, to trap ultra-fine dust created in material handling operations.

Dependable, economical service gained from another Dracco Filter installed at this plant five years ago was the reason Reynolds specified Dracco again.

All collected metallurgical alu-

mina dust is efficiently returned to process, assuring a waste-free production cycle. Problems of abrasive machine wear, high clean-up costs and poor working conditions are avoided.

If you want to obtain these costsaving benefits for your dust collection problem, call in a Dracco engineer. Call or write:

DRACCO DIVISION OF 4040 East 116th Street - Cleveland 5, Ohio

### With Dracco Dust Control **Equipment You Can** -

- recover valuable dust from process
- eliminate health and safety hazards
- improve working conditions
- stop abrasive wear on machinery
- protect vital materials from contamination
- cut plant housekeeping costs
- · halt air pollution

Complete 40-page catalog on Dracco Dust Control Equipment contains detailed data and valuable reference material. Write for Bulletin 800, airstream conveyors
dust control equipment

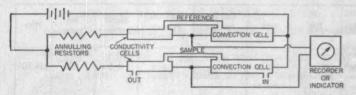


Non-explosion-proof type

Explosion-proof type



M-S-A® Gas Thermatron continuously analyzes for one component in multi-component gas mixtures



Schematic Flow and Wiring Diagram



A non-explosion-proof type of M-S-A Gas Thermatron with recorder mounted in cubicle

This unique development in gas analysis instrumentation combines thermal convection and thermal conductivity effects to provide selective measurement of a single component of a mixture without "scrubbing out" interfering components.

MSA has been applying its knowledge of gas analysis to specific customer problems for over 30 years. Latest and most unique solution to some of these problems is the M-S-A Gas Thermatron.

This unit selectively analyzes for one component of at least a ternary mixture of gases (without removal of any component) by employing both thermal conductivity and thermal convection properties of the gas.

Other standout features: Calibration is possible over very narrow or very wide ranges (0-100% Gas). Construction is rugged. Operation is stable. Maintenance is simple, infrequent. High accuracy and speed of response are inherent characteristics.

In process control, you can use the selective M-S-A Thermatron for analysis of components in hydrogenation, ammonia synthesis, hydrocarbon synthesis and other processes.

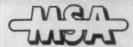
In the area of atmosphere/combustion control, you can analyze for CO<sub>2</sub> or H<sub>2</sub> in atmospheres containing H<sub>3</sub>, CO<sub>2</sub>, N<sub>2</sub>, CO and water vapor. Or, for CO<sub>2</sub> in flue gases.

And where gas purity is a factor, the M-S-A Thermatron is helpful in the analysis of argon, hydrogen, helium or water vapor in oxygen, air or nitrogen.

The MSA Instrument Specialist will welcome an opportunity to relate these advantages to your specific operation. Contact him soon. And write us for informative new bulletin on this inexpensive thermal conductivity analyzer.

### INSTRUMENT DIVISION

Mine Safety Appliances Company
Pittsburgh 8, Pennsylvania





### News trom

### **National Carbon Company**

Division of Union Carbide Corporation • 30 East 42nd Street, New York 17, N.Y. Sales Offices: Atlanta, Chicago, Dallas, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco. In Canada: Union Carbide Canada Limited, Toronto

### National Carbon representatives expand your engineering force



R. L. von HOHENLEITEN, SALES ENGINEER

Mr. von Hohenleiten has spent the past seven years representing National Carbon Company to the chemical processing and allied industries. He was graduated from Johns Hopkins University with a B.S. in chemical engineering and is a registered professional engineer in Texas.

His first few years with National Carbon Company were spent with an engineering group developing new designs and improving existing designs of "Karbate" chemical processing equipment. Von Hohenleiten was first active as a Sales Engineer on the west coast and is now serving customers in the southwestern section of the country.

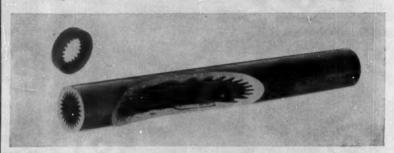
Mr. von Hohenleiten is qualified to aid in the selection, special designing and installing of carbon, graphite and "Karbate" impervious graphite processing equipment. Call your National Carbon Sales Engineer today.

### Low permeability graphite stock available from National Carbon

This low permeability graphite can be used in high temperature applications where greater degrees of imperviousness than obtained with ordinary graphite are required. The material is designated as Code 82 graphite and has a permeability in the range of 1-10 millidarcys. Field tests show this material is well suited for fused salt vessels, thermocouple sheaths and low pressure gas heaters such as those used in the heating of chlorine by the electrical resistance of the tube walls.

Code 82 graphite is available in tubes, cylinders and blocks. Its permeability is uniform and equipment can be machined or fabricated from the stock forms without impairing the degree of imperviousness. For more information contact National Carbon Company, P.O. Box 6087, Cleveland 1, Ohio.

# "Karbate" Internal Low-Fin tube exchangers provide high corrosion resistance at prices comparable to carbon steel exchangers



The following comparison made by a National Carbon Field representative shows the relatively low cost of "Karbate" impervious graphite corrosion resistant heat exchangers using the newly developed internal low-fin tube.

The problem consisted of cooling 150,000 pounds per hour of a sulfonated hydrocarbon mixture from 300°F. to 100°F., using 85°F. water. Heat transfer wise, both "Karbate" impervious graphite and steel could be used. But corrosion wise, plain steel would not be considered for handling sulfonated hydrocarbons. Substituting more corrosion resistant austenitic and mo-

lybdenum stabilized austenitic stainless steel would jump the price of the metal unit two or three times that of the "Karbate" impervious graphite unit. All comparisons are based on units with carbon steel shells and floating end construction.

The low cost extra surface required in the low-fin design reduces the operating heat flux of the unit, and hence the temperature drop through the tube side fouling factor. This means a longer operating cycle between cleanings. Consequently, not only is the "Karbate" unit less expensive to obtain but also it is less costly to maintain.

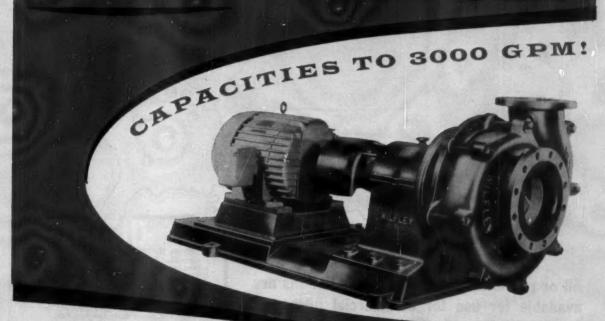
	Exchanger Size		Area	Shell Side Pressure Drop	Tube Side Pressure Drop	Overall Coefficient	Dirt Factor	Price	
	"Karbate" Impervious Graphite	33" I.D. shell with 349 – 1/4" I.D. x16 ft. long internal low-fin tubes.	3360 sq. ft. based on I. D.	13 psig	10 psig 8 pass	69.5	.003	\$16,700	
THE RESIDENCE OF THE PERSON NAMED IN	Steel	45" I. D. shell with 904-1" I. D. x 14 BWGx16ft. long tubes.	3780 based on O.D.	13 psig	10 psig 12 pass	62.0	.003	\$13,700	



The terms "National", "N" and Shield Device, "Karbate" and "Union Carbide" are registered trade-marks of Union Carbide Corporation.



# WILFLEY BIRGH ACTO POM



### SUPERIOR PERFORMANCE!

Now Wilfley's famous line of Model "AF" Acid Pumps includes
1" to 8" discharge sizes with 10 to 3000 GPM capacities, and heads up
to 200'! This new 8" pump incorporates the same dependable, economical
features that characterize all Wilfley Acid Pumps...continuous, trouble-free
operation, lower maintenance costs, longer pump life, higher output.

Wilfley Acid Pumps are available with pumping parts of the machinable alloys as well as plastic to meet all requirements.

### INDIVIDUAL ENGINEERING ON EVERY APPLICATION

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### PROPOSALS SOLICITED FOR LEASE OF DEPARTMENT OF THE ARMY INDUSTRIAL FACILITIES



### All or portions of the above installations are available for use for commercial purposes. Possible uses are unlimited.

Facilities: Oleum plants (sulphuric acid); nitric acid; acid concentration; ether still; nitrocellulose; various explosive manufacturing; organic chemical manufacturing; steel foundries; heavy and light manufacturing; loading and assembling; offices; warehouses; power plants; storage tanks; many other facilities.

Transportation: Rail and highway facilities are available to these installations, including intra-plant rail and road systems.

Utilities: All necessary utilities are available.

Labor: There is a surplus of both skilled and unskilled labor in the immediate vicinity of most plants.

Detailed information, arrangements for inspections, invitations for proposals and sample form of lease may be obtained from the U. S. Army Division Engineer having jurisdiction over the area in which you are interested. The addresses of the Divisions Engineers are:

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SOUTH ATLANTIC PO Box 1889 Atlanta, Georgia

OHIO RIVER PO Box 1159 Cincinnati, Ohio

NORTH CENTRAL 536 So. Clark St. Chicago 5, III.

NORTH ATLANTIC 90 Church St. New York 7, N. Y.

SOUTH PACIFIC PO Box 3339 Rincon Annex San Francisco, Calif.

SOUTHWESTERN: 1114 Commerce St., Dallas, Texas

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Kansas Ordnance Plant, Parsons, Kansas
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Nebraska Ordnance Plant, Wahoo, Nebr.
Rocky Mountain Arsenal, Denver, Col.
St. Louis Ordnance Plant, St. Louis, Mo.
Sunflower Ordnance Works, Lawrence, Kansas

Birdsboro Ordnance Steel Foundry, Birdsboro, Pa.
 Burlington Ordnance Plant, Burlington, N. J.
 Edgewood Arsenal, Edgewood, Md.
 Ordnance Assembly Plant, Edgewood, Md.
 Radford Arsenal, Radford, Va.

### NORTH CENTRAL

1. Badger Ordnance Works, Baraboo, Wisc.
2. East Chicago Ordnance Steel Fdy., East Chicago, Ind.
3. Joliet Arsenal, Joliet, III.
4. Kingsbury Ordnance Plant, La Porte, Ind.
5. Twin Cities Arsenal, New Brighton, Minn.
6. Wabash River Ordnance Works, Newport, Ind.

Coraopolis Ordnance Steel Foundry, Coraopolis, Pa.
 Indiana Arsenal, Charlestown, Ind.
 Jefferson Proving Ground, Madison, Ind.
 Lima Ordnance Steel Foundry, Lima, Ohio
 Marshall Plant, New Martinsville, W. Va.
 Ravenna Arsenal, Apco, Ohio
 Ridgewood Ordnance Plant, Cincinnati, Ohio

### SOUTH ATLANTIC

Alabama Ordnance Works, Childersburg, Ala. Holston Ordnance Works, Kingsport, Tenn. Milan Arsenal, Milan, Tenn. Phosphate Development Works, Sheffield, Ala. Volunteer Ordnance Works, Tyner, Tenn.

### SOUTH PACIFIC

Pacific Ordnance Steel Foundry, Pittsburg, Calif.
 Riverbank Ordnance Plant, Riverbank, Calif.

### SOUTHWESTERN

- Lone Star Ordnance Plant, Texarkana, Texas Longhorn Ordnance Works, Karnack, Texas Louisiana Ordnance Plant, Shreveport, La. Oklahoma Ordnance Works, Pryor, Okla. Pantex Ordnance Plant. Amazilio. Texas

CORPS OF ENGINEERS, U.S. ARMY



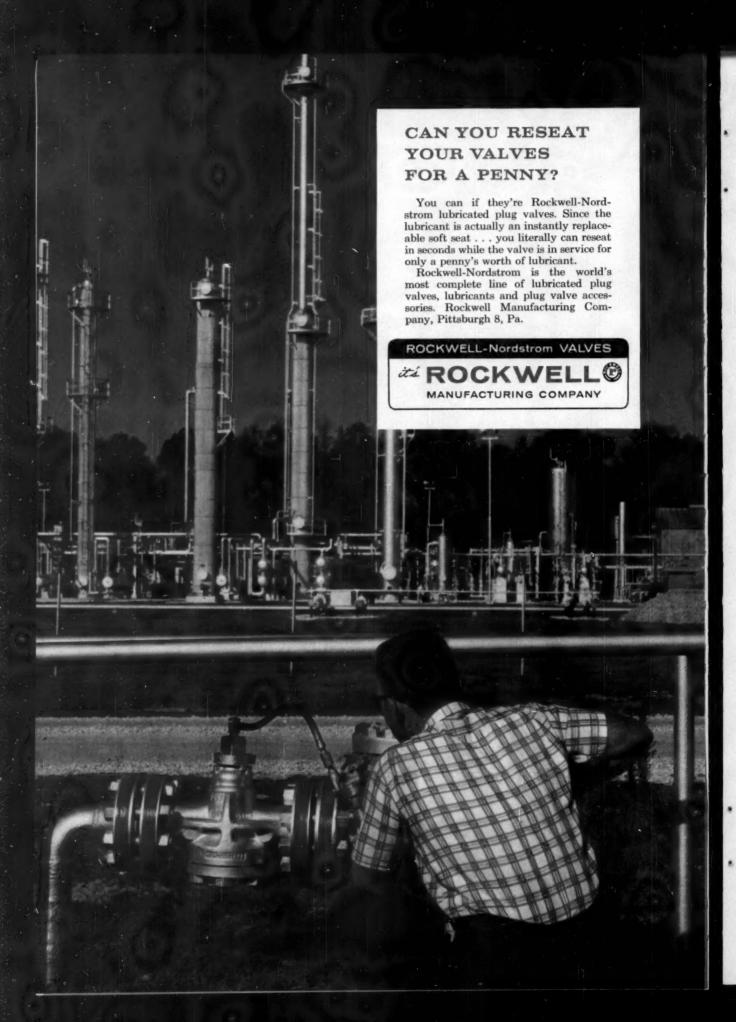
# CACID IT TAKES A VALVE WITH

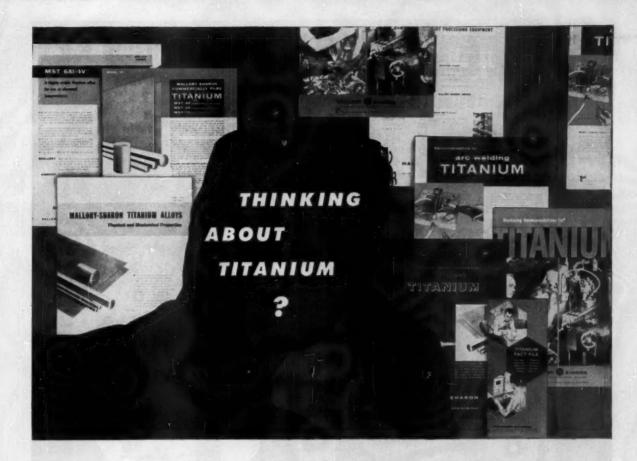
"GUTS" to stay trouble-free and seal tightly on acid and slurry service . . . it takes a Rockwell-Nordstrom lubricated plug valve. Fully protected seats and pressurized lubricant sealing insure positive shut-off, trouble-free operation. Since they cost no more to buy, you pay less for "premium" performance.

Rockwell-Nordstrom is the world's most complete line of lubricated plug valves. Rockwell Manufacturing Company, Pittsburgh 8, Pa. ROCKWELL-Nordstrom VALVES

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### Help yourself to this helpful data

Mallery-Sharen, as a pioneer in titanium technology and largest integrated producer of special metals, offers you a wealth of technical assistance . . . both in print and in person.

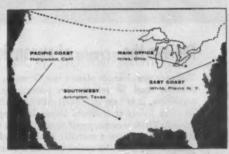
Technical bulletins on titanium's properties and advantages are available through Mallory-Sharon headquarters or sales offices. They're yours for the asking. Use coupon below.

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Arc Welding Titanium

Mallory-Sharon Metals Corporation
Niles, Ohio

Please send me the technical bulletins on titanium checked at left.

Name

MST 6AI-4V Titanium Alloy

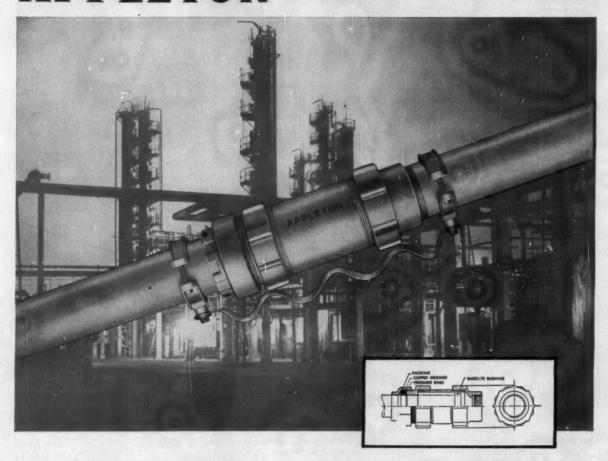
Commercially Pure Titanium

Corrosion Properties of Titanium

Address

City & State

# APPLETON "XJ" Conduit Expansion Joints



### Relieve the strain of expansion and contraction on long runs of rigid conduit

Temperature changes place a terrific strain on all long conduit runs. To relieve this potentially dangerous condition, it is best to install APPLETON "XJ" Expansion Joints at frequent intervals along the entire system. These weatherproof joints, for use with heavywall conduit, have a metallic packing and a bonding jumper to assure the entire conduit system remains a continuous electrical conductor. The jumper, installed in accordance with U.L. recommendations, gives double protection against extreme expansion movement reducing the effectiveness of the metallic bond.

As the conduit is inserted in the joint, a bushing is placed on the end in the manner shown. This bushing permits maximum conduit movement and yet the conduit can never pull free of the joint. The APPLE-TON "XJ" Conduit Expansion Joint features a metallic packing and pressure ring at the flexible end to keep the joint weatherproof at all times.

Wherever a long run conduit installation exists, the need for APPLETON "XJ" Expansion Joints exists. Interior or exterior, from Texas to Maine, temperature strains do exist, so take advantage of APPLETON'S product research program to give you the precision products you require . . . APPLETON "XJ" Weatherproof Expansion Joints for all long run conduit installations.

Sold Through Franchised Distributors Only



PPLETON ELECTRIC COMPANY

1701 Wellington Ave., Chicago 13











### down go costs and delivery time for the process industries

It's here . . . the most versatile heat exchanger ever developed for the chemical industry—the Ross C-100. Of quality construction throughout, it is pre-engineered and fully standardized, by-passing high costs and delays inherent in custom fabrication.

Readily assembled to handle any combination of liquids and gases, the C-100 can be used as a heater, cooler, condenser or vaporizer for hundreds of process applications.

Extreme flexibility predominates . . . in materials, sizes and arrangement of components, mounting position, tubeside passes, nozzle orientation. Your choice is virtually limitless in meeting a tremendous range of conditions.

Want specific details? New illustrated Bulletin 302.5K1 will bring you all the facts on design, materials, sizes and adaptability. Send the coupon for your copy.

\*American-Standard and Standard ® are trademarks of American Radiator & Standard Sanitary Corporation.



Mail this coupon for new Bulletin



Please send your new illustrated Bulletin 302.5K1 fully describing the Ross Type C-100 Heat Exchanger.

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WE wouldn't be in business, if YOU couldn't

# cut costs with these unusual refractories!



Nothing resists abrasion like an abrasive, such as silicon carbide. Here, for example, is a CARBOFRAX lining that outlasted hard-fired brick on the order of 3 years to 6 months. That's why so many operators are using CARBOFRAX linings in dust collectors, downcomers, coke chutes, and similar equipment exposed to severe wear.



Pictured here is the oil-fired furnace mentioned in the copy. It's used for working 450-lb. drill bits. The dull bits are heated in the right-hand opening to 2000 F, then dressed and returned to the left opening for tempering at 1450 F. At the time of this photo, our refractories had been used for well over 3000 hours—were still in good condition.



The three parts of this furnace that take the most abuse are each made of CARBORUNDUM's super refractories. The hearth and skid rails are silicon carbide. The piers are our electric furnace multite—still going strong after five years. The skids, when pictured, had been in service three years with no replacement necessary.

Take advantage of the one good thing to come out of the recession: EXTRA TIME . . . time to look around . . . time to spot areas where better materials will give you better service—and help cut your operating costs.

For instance: Those "vulnerable" areas in your furnace—i.e. areas subjected to flame impingement or heavy loads, or exposed to abrasion or corrosion. Or other "working" areas where heat must pass through the refractory. In these spots, you may profit handsomely by substituting one of our special-purpose refractory materials. Materials designed specifically to meet these conditions.

- For example: One customer replaced hard-burned, acid-proof brick in the vertical wall area of a cyclone dust collector with our CARBOFRAX® silicon carbide lining. After three years' service, the CARBOFRAX lining still shows practically no wear. Whereas before, the lining was badly cut out after only a few weeks. Quite a saving! . . . in materials, in labor, in downtime.
- B For example: The sidewall, backwall and main arch of an oil-fired furnace were replaced with Carborundum's super refractories because the operator was getting only three months life. After the changeover, life increased 300%!
- **6** For example: In another furnace, 300-lb. annealing baskets and 50-lb. motor heads were pushed directly over a fireclay hearth. But maintenance costs were so high that a CARBOFRAX hearth was substituted. This not only solved the maintenance problem, but also transmitted the heat rapidly—and made possible a saving of one third in fuel.

Granted, Carborundum's refractories cost more. But they also save much more—in terms of refractory life . . . furnace downtime . . . and maintenance costs. They also do more—in terms of higher furnace output . . . faster heat transfer . . . and increased efficiency. In short, we wouldn't be in business if you couldn't cut costs with super refractories.



Here's how you can start cutting costs:

It will take less than an hour to read these two booklets about the applications — and properties — of Carborundum's unique, new super refractories. Send for them today.

### Subscription to "Refractories"

is yours for the asking. This technical brochure is published approximately every other month; contains a wealth of information on new refractory materials, lining techniques, etc. Offer limited, so write soon.

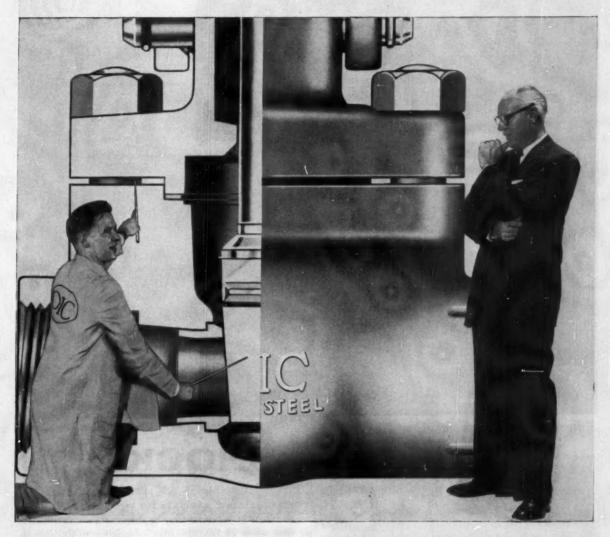


Refractories Division, The Carborundum Company, Perth Amboy, N. J., Dept. H-108.

CARBORUNDUM

Registered Trade Mark

...and you can see here....and here, sir,
how we've killed maintenance problems
on our new forged steel lines.



We stop galling and erosion by giving you 13% chrome stainless steel trim with wedges duracased to a rugged 1000 Brinell hardness.

The square and bolted body-bonnet joint makes it easy to service the valve quicker. And it's a tighter joint, made doubly leakproof by recessing the soft iron gasket into the body. The gasket can't blow!

And you get the fastest joint make-up you've

ever seen. Look at those pipe ends. See the extra wrench-gripping area and lugs. See how bodybonnet flanges are out of the wrench's way. No time lost here!

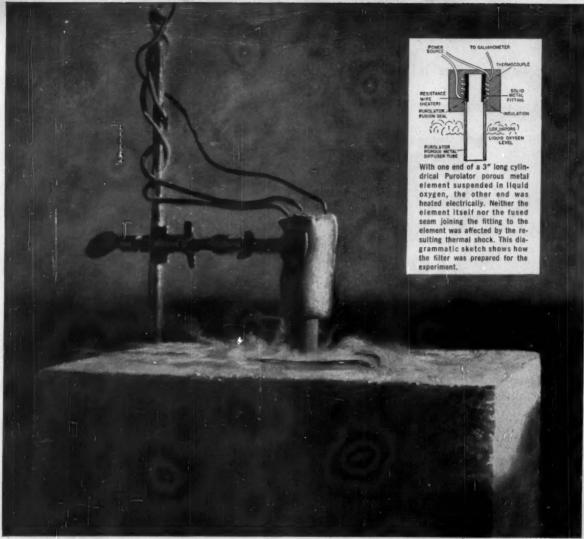
These new 600-lb. OIC forged steel valves are available with either high-flow ports (1300 line), or standard-flow ports (1100 line). Call your OIC Distributor, or write for specification literature.

The Ohio Injector Company \* Wadsworth, Ohio



BRONZE, IRON, PORGED AND CAST STEEL, LUBRICATED PLUS VALVES





Filters for extreme conditions . . .

### THERMAL SHOCK

Purolator metal filter media can take it

How much thermal shock can a filter withstand?

In a recent series of experiments, various samples of Purolator metal filter media stood up under temperature gradients, across short lengths, of up to 500°F...and could have taken more. There was no effect on filter efficiency. Thermal shock is only one of the difficult operating problems Purolator's staff of "Q" and "L" cleared-filtration experts handle regularly. They can design and produce the exact filter needed to remove any known contaminant from any known fluid under any operating conditions. They have produced filters and separators to operate within the following wide ranges of conditions:

TEMPERATURES: from -420° to 1200°F.

PRESSURES: from a nearly perfect vacuum to 6,000 psi.
RATES OF FLOW: from drop by drop to thousands of GPM.
DEGREES OF FILTRATION: from submicronic to 700 microns (in various media).

No other filter manufacturer can offer such complete services to handle so wide a range of tough operating conditions.

These brochures outline what Purolator can do for you, or, if you have an urgent filtration problem, call Jules Kovacs, Vice President in charge of Technical Sales... or send him the details of your application.

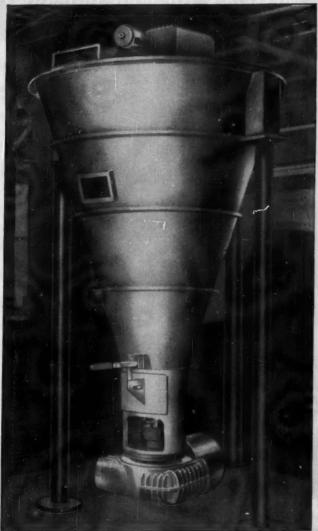


Filtration For Every Known Fluid

### PUROLATOR

PRODUCTS. INC.

RAHWAY, NEW JERSEY AND TORONTO, ONTARIO, CANADA



### Buflovak Nauta Mixer blends faster... takes less power... improves production

A new motion in mixing sets a new standard for blending dry materials of all kinds. Precessional motion, exclusive in Buflovak's Nauta Mixer, gives gentle positive action for uniform dispersion without dusting. A revolving screw flight travels around the interior of a stationary cone body . . . lifts the material to the top as it swings around the inside surface.

The results: intimate mixing even when handling materials of different fineness, different specific gravities. And Buflovak's unique design assures uniform mixing when using additives, wetting materials or dissolving solids in liquid media.

Available in models ranging in capacity from 10 to 125 cubic feet, Nauta Mixers do a more thorough job on a shorter mixing cycle to boost production and cut costs.

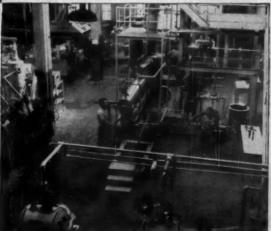
Send for Catalog 382 today. Additional facts are also available in the Chemical Engineering Catalog, pages 429-452.

### Pre-test your mixing operation in Buflovak's

### Customer Service Laboratory

If your processing problem involves mixing, drying, evaporation, extraction, impregnation, crystallization or other related processes you can find the answers at the Buflovak Laboratory.

Equipped with an extensive line of small-scale and pilot-size units and staffed with experienced engineers, this research center has solved over 7000 processing problems. Whether you test a few beakers of material or make a full scale production run, you get positive results. Write for Bulletin 381.

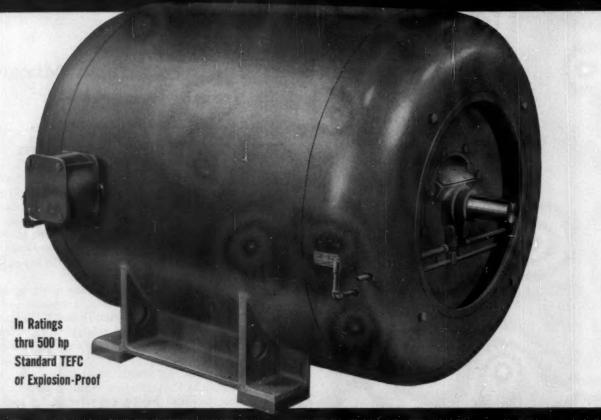




### BLAW-KNOX COMPANY

Buflovak Equipment Division
1551 Fillmore Avenue, Buffalo 11, New York

### Need COOLER RUNNING MOTORS for your big jobs?



### WAGNER Tube Ventilated Motors can solve your problem

For big fans, blowers, pump drives-heavy duty applications where you need large motors with highly effective cooling systems for long life-choose Wagner Tube Ventilated Motors.

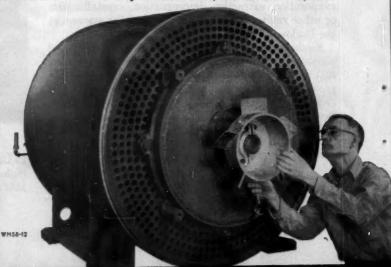
These motors have fabricated steel frames that are provided with a series of tubes through which cooling air is forced by an external blower. Internal blowers, one at each end of the rotor, circulate the warm air inside the motor through ducts in the rotor and stator and around the cooling tubes. This effective cooling system holds the operating temperature of the motor within the specified limits of 55° C Rise for Class A or 75° C for Class B insulated motors.

Wagner tube ventilated motors are available as Type YP, standard TEFC, with Class A or Class B insulation; or as Type ZP, explosion-proof, with Class A insulation only. Type ZP motors can be supplied with Underwriters' Labels for Class I, Group C or D, or for Class II, Group E, F or G locations. Let your Wagner Sales Engineer show you how these motors can solve your big motor problems.

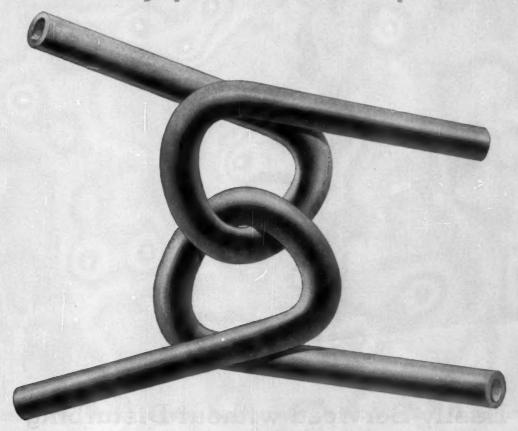
WAGNER ELECTRIC CORPORATION . 6407 Plymouth Ave., St. Louis 14, Mo.

This 400 hp tube ventilated motor is being tested on a 1000 hp dynamometer at the Wagner plant. Photo of motor at right, with blower shield removed, shows cooling tubes and external blower.





PUZZLED by pressure tube problems?



# Let Timken Company metallurgists select the <u>one</u> steel analysis that gives you maximum tube life per dollar

AVARIETY of high temperature steels can handle the combination of pressure, temperature and corrosion that your operation creates. But only one steel analysis can handle your problem in the most economical way, give you maximum tube life per dollar.

Timken Company metallurgists can find it for you fast. They're recognized experts in high temperature steels because they're backed up by more than 25 years of research and experience. They've solved hundreds of industry's toughest pressure problems—economically. Ask these experts for help and you can be sure of getting the best possible tube life per dollar.

And we've got the steels to do the trick. You can get Timken® seamless pressure tubes in sizes up to 11"
O.D. x 3¼" wall—available in all stainless and alloy grades to meet almost any combination of operating conditions. And because we make only electric furnace fine alloy steel, you can be sure of accurate analysis, uniformity from heat to heat, order to order, tube to tube.

Why not save money by letting Timken Company metallurgists solve your pressure problem? The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

TIME STEEL

SPECIALISTS IN FINE ALLOY STEELS. GRAPHITIC TOOL STEELS AND SEAMLESS STEEL TUBING

CHEMICAL ENGINEERING-October 20, 1958

127



# Easily Serviced without Disturbing PIPING-WIRING-ALIGNMENT

The complete drive unit, including the impeller, of this new Type SZ LaBour pump is removable as a unit for replacement or maintenance—leaving piping and motor undisturbed and in perfect alignment.

Although Type SZ is a non-priming pump, its design permits it to handle large quantities of air or gases mixed with the liquid, so that aerated solutions or volatile materials—within reasonable limits—cause no trouble whatever. The fully open impeller and absence of sealing rings or other closely fitted pumping parts give this pump the ability to move dirty liquids without clogging or loss of efficiency.

LaBour dependability, long the recognized top in the industry, is built into this newest LaBour unit. Practically any requirement as to corrosionresistant materials can be met.



Full particulars are yours for the asking. Why not write today?

ORIGINAL MANUFACTURERS OF THE SELF PRIMING CENTRIFUGAL PUMP

# LABOUR

THE LOBOUR COMPANY, INC. . ELKHART, INDIANA, U.S.A.





### Working wonders out of waste!

This quadruple-effect evaporator concentrates antibiotic liquids for E. R. Squibb & Sons, New Brunswick, N. J. Developed for the handling of streptomycin waste, it demonstrates Swenson's ability to help advance the production of new pharmaceuticals put into service for humanity.

Send for Processing Profiles, the authoritative new color booklet of perform-

ance reports! It shows Swenson products on the job . . . bringing higher efficiency and quality to all the processing industries. Remember, what Whiting's Swenson Evaporator Division has done for others can

be done for you. Swenson Evaporator Company, 15669 Lathrop Avenue, Harvey, Illinois.



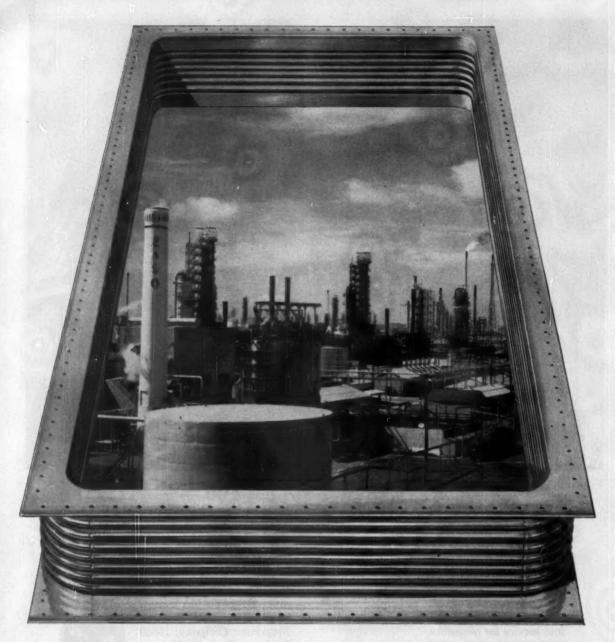
87 OF AMERICA'S "FIRST HUNDRED" CORPORATIONS ARE WHITING CUSTOMERS

SWENSON

Proved Engineering for the Process Industries Since 1889



WHITING, MANUFACTURERS OF CRANES, TRAMBEAM HANDLING SYSTEMS, TRACKMOBILES, FOUNDRY AND RAILROAD EQUIPMENT.



### Giant refineries like Esso Baton Rouge use Sola-Flex® Expansion Joints

FORTY OF AMERICA'S FIFTY largest businesses—power, petro-chemical, nuclear and others—use Sola-Flex expansion joints to help solve difficult piping problems. The giant Esso refinery at Baton Rouge has installed 6 ft rectangular Sola-Flex joints in some of its critical equipment where it is necessary to handle difficult extremes of thermal growth and vibration.

Solar manufactures the most comprehensive line of expansion joints in the world. They are made in a wide variety of stainless and high-temperature alloys in a complete range of sizes, from ½ in. to 35 ft in diameter. Temperatures range from -320F to 1200F; pressures from complete vacuum to 600 psi and up. And rugged, economical Sola-Flex joints can be "in service"

one to four weeks after receipt of order!

A new pamphlet describes Solar's complete line of Sola-Flex expansion joints. Write for it to Dept. F-78, Solar Aircraft Company, San Diego 12, Calif.





the blower that keeps air fresh

Your men can't produce at top efficiency when stagnant, hot or fume-filled air robs them of their energy.

Wherever bad air slows down production
. . . in shipholds, tanks, drums, boilers or
other places where men need fresh, cool air
. . . a Coppus Blower becomes both a safety
device and a production tool.

Portable and easily adaptable for special purposes, Coppus "Blue Ribbon" blowers and Exhausters fit all your "fresh air" requirements. The Coppus "Blue Ribbon" means premium performance at ordinary cost. Check and mail the coupon for specific information. Sales offices in THOMAS' REGISTER. Other "Blue Ribbon" Products in CHEMICAL ENGINEERING CATALOG, REFINERY CATALOG, BEST'S SAFETY DIRECTORY, MINING CATALOGS.

# COPPUS "BLUE RIBBON" PRODUCTS



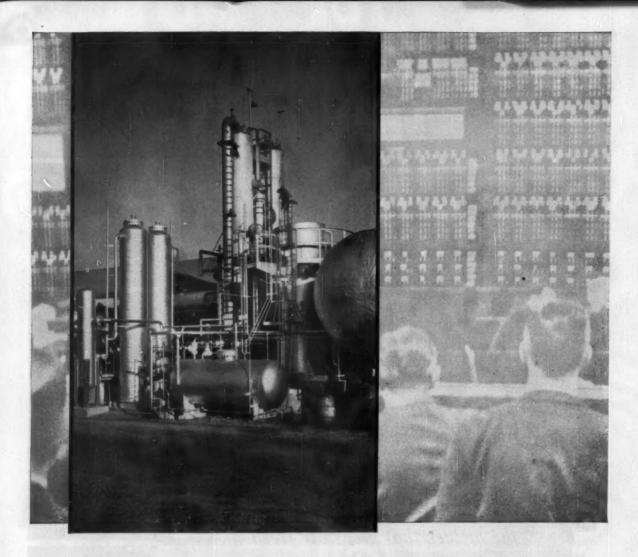






MAIL THIS COUPON! To Coppus Engineering Corp., 231 Park Avenue, Worcester 2, Mass.

In tanks, tank cars, drums, etc.  in underground cable manholes.  in seroplane fusilages, wings, etc.  on coke ovens.  on steam-beated rubber processes.	on boiler repair jobs.  COOLING:  motors, generators, switchboards.  wires and sheets.  general man cooling. around cracking stills.	exhausting welding fumes.  stirring up stagnant air wherever men are working or material is drying.  drying of walls, sheets; etc., after treated with coating material.	COMPANY ADDRESS CITY
(Write here any special venting problem you may have.)	ilat-		



# Turns waste gas into dry ice...through Pritchard's GOOD FINANCIAL DESIGN

How to make dry ice economically from impure waste CO<sub>2</sub> gas. That was the crux of the problem in the design and construction of Allied Chemical's dry ice plant at Hopewell, Va.

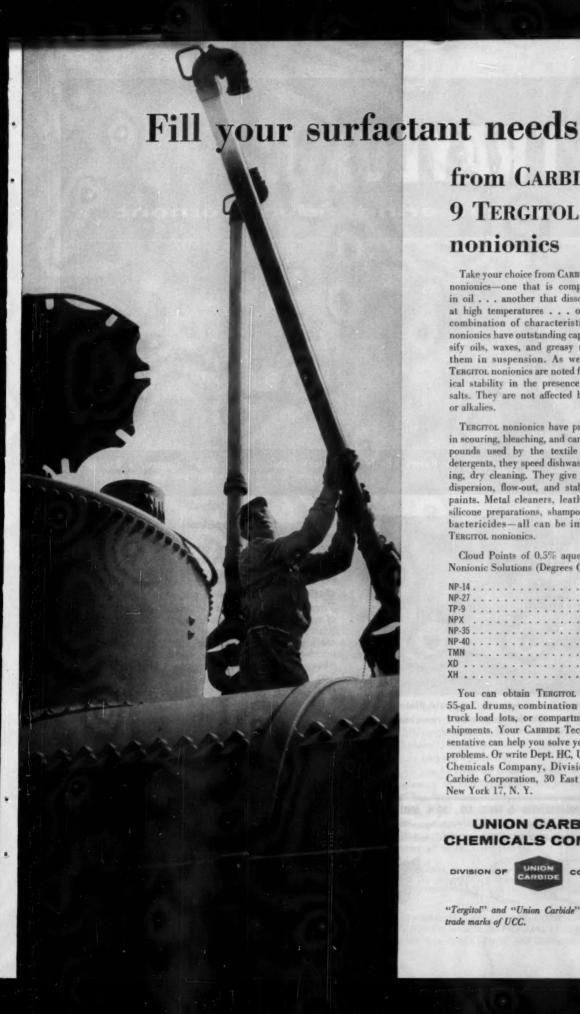
J. F. Pritchard & Co., engineers and contractors for the plant, not only found the answer but devised a unique process (now patented) that enabled Allied to strip out the contaminating elements—hydrogen and nitrogen—and use them to produce ammonia. Allied completely utilizes its raw gas and turns what looked like a waste material into marketable commodities.

This is another example of Pritchard's good financial design in action in the chemical industry. But good financial design is more than creative engineering alone, more than astute planning and purchasing, more than cost-conscious construction. It's the combination of these

factors in such a way that a Pritchard-built plant makes maximum return per dollar invested.

Pritchard's broad experience in building chemical facilities and sound business approach to technical construction are at your service—to help you build for greater profits. We'll be glad to send you details of our complete engineering and construction service for the chemical industry.





### from CARBIDE'S 9 TERGITOL nonionics

Take your choice from CARBIDE's TERGITOL nonionics-one that is completely soluble in oil . . . another that dissolves in water at high temperatures . . . or one with a combination of characteristics. TERGITOL nonionics have outstanding capacity to emulsify oils, waxes, and greasy soils-to hold them in suspension. As wetting agents, TERGITOL nonionics are noted for their chemical stability in the presence of acids and salts. They are not affected by hard water or alkalies.

TERCITOL nonionics have proved effective in scouring, bleaching, and carbonizing compounds used by the textile industry. Asdetergents, they speed dishwashing, laundering, dry cleaning. They give good pigment dispersion, flow-out, and stability to latex paints. Metal cleaners, leather dressings, silicone preparations, shampoos, adhesives, bactericides-all can be improved with TERGITOL nonionics.

Cloud Points of 0.5% aqueous TERGITOL Nonionic Solutions (Degrees C.)

NP-14	*	*				*				In	soluble
NP-27											20
TP-9											51-56
NPX											60-65
NP-35											90-95
NP-40											100
TMN											35-37
XD .											60-65
XH .	Q								-		90-100

You can obtain TERGITOL nonionics in 55-gal. drums, combination car load or truck load lots, or compartment tank car shipments. Your CARBIDE Technical Representative can help you solve your surfactant problems. Or write Dept. HC, Union Carbide Chemicals Company, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y.

### UNION CARBIDE CHEMICALS COMPANY

DIVISION OF



CORPORATION

"Tergitol" and "Union Carbide" are registered trade marks of UCC.

# TRAYLOR-MADE

is engineering advancement



9'-6" diameter x 375'-0" Traylor Rotary Kiln in a Portland Cement plant.



Plant installation of 9'-6" diameter x 250'-0"
Traylor Rotary Kiln in Portland Cement plant.



Illustrated is one type of Traylor's Pinion Mountings with the gear guard removed.

Traylor engineering experience in the building of kilns satisfies the demand upon process industries for greater production, and offers many advantages. One Traylor-Made kiln advancement is the "full-floating" type of tire. Special mounting of these tires holds them securely in place but permits them to float free of the shell as it contracts and expands.

Traylor-Made kilns are revolved by means of a train of spur gears. The main or girth gear is of cast steel with high addendum machine-generated teeth. The main pinion is of cast, forged or tool steel with low addendum machine-generated teeth. All gears are of heavy proportions to take care of shock load, wear and life expectance.

Call on the experience of Traylor engineers for your machinery needs.

Write for bulletin No. 1115 today!

TRAYLOR ENGINEERING & MFG. CO., 2000 MILL ST., ALLENTOWN, PA.

Sales Offices: New York — Chicago — San Francisco
Canadian Mfr.: Canadian Vickers, Ltd., Montreal, P. Q.













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# Is Wyandotte technical service a one-man band?

Definitely not!

And no one realizes this more than we do at Wyandotte.

That is why we have practical men technically trained to serve the pulp and paper industry . . . who work with the soap or detergent industry . . . while others devote their activities to the chemical, pharmaceutical, and petroleum fields.

These men are also available to bleachmakers, concrete companies, rubber and plastic manufacturers, and the many other industries we serve.

What can these men do for you?

They can give you the kind of helpful technical assistance your scientists need and

They can supply background information on the application of our products to yours.

They can give you the chemical and physical properties along with other pertinent characteristics on each of our products . . . their specifications and limitations.

Equally important to you, they can provide valuable application data on our products that may result in distinct advantages to you. They can also arrange consultation with our science-specialists\* on new product problems which our products may help solve.

Although far from being a one-man band, Wyandotte technical service can be sweet music to your ears.

All you have to do to take advantage of it is give us as much background material as you can on your product or processing problem, so that we can tailor our services to meet your needs.

For a pictorial presentation of technical service at work, turn the page.

\*Chemists, chemical engineers, physicists, etc., whose industrial or research experience qualifies them as specialists in their particular field.



SODA ASH • CAUSTIC SODA • BICARBONATE OF SODA • CALCIUM CARBONATE • CALCIUM CHLORIDE • CHLORINE • MURIATIC ACID • HYDROGEN • DRY ICE GLYCOLS • SYNTHETIC DETERGENTS (anionic and nonionic) • CARBOSE® (Sodium CMC) • ETHYLENE OXIDE • ETHYLENE DICHLORIDE • PROPYLENE OXIDE • PROPYLENE DICHLORIDE • PROPYLENE OXIDE • DICHLORODIMETHYLHYDANTOIN • CHLORINATED SOLVENTS • OTHER ORGANIC AND INORGANIC CHEMICALS

### Figuring the economics of 50% vs. 74% liquid caustic



... an example of Wyandotte technical service at work



1 A user of liquid caustic soda studies Wyandotte literature showing possible savings by switching from 50% to 74% material. From it, he gets a basic understanding of his own economic position, calls in a Wyandotte technical-service man.



2 The Wyandotte technical-service man analyzes the problem with respect to the customer's continuous growth; brings to light savings of thousands of dollars in freight charges by changing to 74% liquor-recommends the proper equipment... the changeover was accepted.



3 Wyandotte engineers—with broad experience in applications of caustic soda and the correct equipment for its proper handling—assist in designing heat exchangers, coolingtower piping, storage tanks, and materials of construction.



4 The Wyandotte technical-service man keeps in touch during new construction. When problems arise, such as the location of equipment for most efficient operation or more economical installation... alternate valves or new materials of construction...he is available for advice.

Stepped-up use of caustic, or changes in freight rates, can alter your economic position in relation to 50% vs. 74% concentrations almost overnight. That's why it's wise to survey your requirements periodically. Wyandotte technical service, as demonstrated on this page, is available to Wyandotte customers and prospects. If you have a problem concerning caustic soda, or any product within our technological or manufacturing background, check with us . . . our approach is designed to provide answers. Wyandotte Chemicals Corporation, Michigan Alkali Division, Wyandotte, Michigan. Offices in principal cities.



Pacing progress with creative chemistry

5 The technical-service man is on hand to help unload the first tank car of 74% caustic ... seeing that outlet leg is properly steamed, diluting water correctly proportioned, temperature controlled, safety precautions followed.



### ALLIS-CHALMERS Compacting **Process**

... more economical than any other method of agglomeration



**Equipment** used with compactor or used independently







### **Upgrade for Profits** ... Mechanically

Precise control of particle size, density and solubility factors is now assured with the Allis-Chalmers compacting process. The heart of this efficient, completely mechanical system is this new Allis-Chalmers compacting mill.

### **Converts Loss into Profit**

By-product material, too fine for use, from the original process, is first densified into slabs or flakes in the compacting mill. Agglomerated product is then granulated in the rollertype mill and separated in the vibrating or gyratory screen. This conversion of by-product material into a usable product changes loss into added profits.

Get Bulletin 07B8836 for the complete story. Ask your A-C representative for a copy, or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.



Aero-Vibe is an Allis-Chalmers trademark.



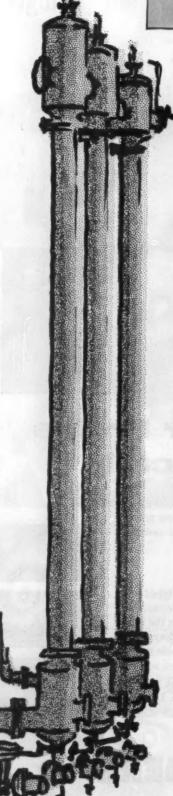
### LIS-CHALMERS







### PROCESS FLOWSHEET C. H. CHILTON



Four-story solvent extraction columns perform key operation in Davison's new . . .

### **Shortcut to Uranium Fuels**

February 27, 1958, marked a significant milestone in the development of this country's nuclear industry: On that date the Atomic Energy Commission gave its blessing to the sale of uranium concentrates direct from Uranium Reduction Co.'s Moab, Utah, ore processing mill to Davison Chemical Co.'s nuclear fuels plant at Erwin, Tenn.

Until the granting of that historic license, all uranium-bearing materials-even unenriched -had to be secured from the Government. Now, direct flow of uranium "yellow cake" concentrates from mills to nuclear fuel plants cuts down total number of operations needed to make unenriched fuels (Chem. Eng., Aug. 25, 1958, p. 53) and eliminates time lost in small-lot purchases from AEC. (The Commission is still the only source of uranium enriched in U-235, however.)

Too, the unfreezing of yellowcake output by AEC gives uranium mills a new potential outlet for product not contracted for by AEC.

▶ Accent on Flexibility—Davison's \$2-million nuclear fuels plant at Erwin is said to be the largest in this infant industry. Production capacity in terms of uranium metal is around 1 million lb./yr.—more than enough to supply this country's present demand.

But despite its relatively large size, Davison's operation

is still primarily on a custom basis. From three basic raw materials—uranium ore concentrates, thorium ore concentrates, thorium ore concentrates and enriched UF—plant produces a wide range of nuclear materials. Major products are uranium and its alloys for metallic fuel elements and uranium dioxide powder for ceramic elements. Installation also turns out such esoteric materials as depleted UO<sub>2</sub> for ceramic colorings and thorium metal for electronics applications.

Plant is unique in size and scope of products. Although processes and techniques are based on procedures developed originally by AEC, Davison did some original equipment design to streamline the basic flowsheet.

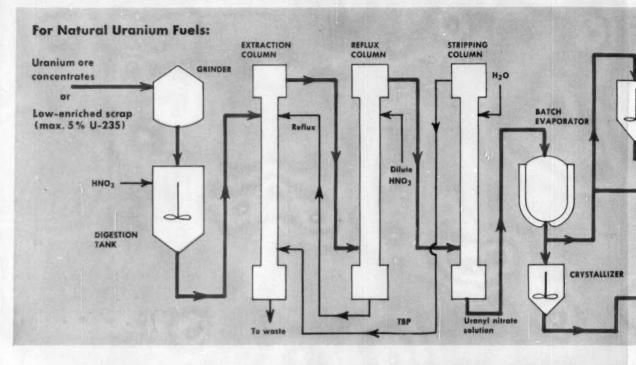
Planning for Growth-Davison's flexible installation is a commentary on the fledgling status of the nuclear power industry today. Summing up the design philosophy that went into the plant, Technical Director E. R. Johnson states: "Our primary consideration was to build a versatile facility which could serve the nuclear power industry in its research and development phase today as well as supply nuclear fuel later on when we reach mass-production proportions."

When the industry becomes more standardized, Davison envisions a mass-production fa-

**Unfold Flowsheet** 







cility adjacent to its present plant, with the latter assuming the task of specialty production.

Solvent Extraction — Davison now makes all unenriched uranium products directly from ore concentrates.

First, concentrates are dissolved in nitric acid and uranium extracted with tributyl phosphate in kerosene. Uranium is stripped from solvent phase with water, forming a uranyl nitrate solution that can be processed into several products as indicated on the flowsheet.

Solvent extraction steps are carried out in perforated-plate pulse columns, 40 ft. high and 6 in. dia. Columns are made of stainless steel and fed by positive-displacement pumps.

▶ Dioxide or Metal—To make uranium dioxide, uranyl nitrate solution is decomposed to UO<sub>2</sub> at 400 F. in an electrically heated pot. Reacting with hydrogen at 1,200 F. in a tube furnace reduces UO<sub>2</sub> to UO<sub>2</sub>.

To make metallic uranium, UO, is fluorinated with HF at 1,100 F. in a rotary kiln fitted with an Inconel reaction tube. Resulting UF, is mixed with magnesium in twin-shell blender and charged to electrically heated reduction furnace. After 1,200-F. reduction, resulting uranium metal derby (so named because it's shaped like a derby hat) is

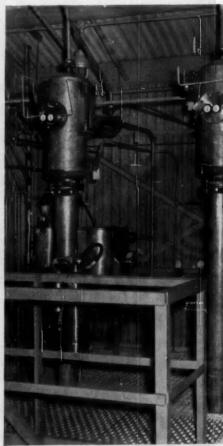
melted and cast into ingots in a vacuum induction furnace. Uranium can also be alloyed during the melting operation.

▶ Making Hot Fuels—Process to make enriched fuels starts with UF₀ obtained from an AEC gaseous diffusion plant. Size of equipment used is inversely proportional to enrichment; for highly enriched material (over 5% U-235) equipment is almost laboratory size.

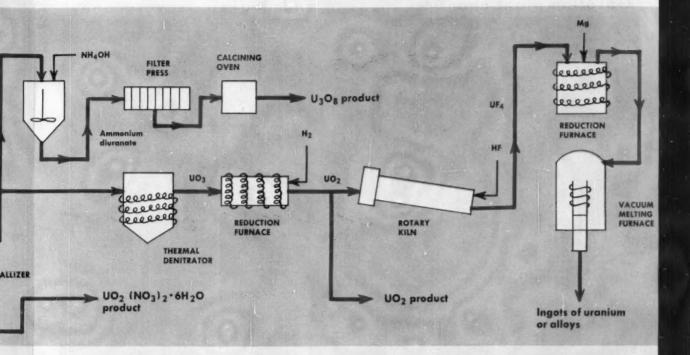
To make metal, UF. gas and hydrogen are piped to top of a vertical reactor with Monel tubes. Reaction at 1,150 F. produces UF. "green salt" that leaves bottom of reactor through a rotary valve.

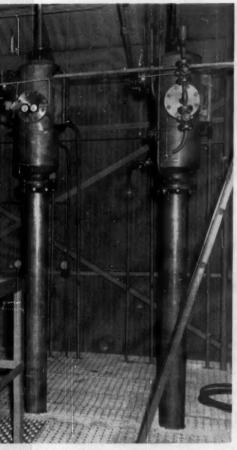
Green salt is blended with magnesium and charged to a reduction furnace. For high U-235 enrichments, calcium reducing agent is employed because it gives more complete recoveries of highly valuable enriched uranium.

Enriched uranium oxides are made by hydrolyzing UF<sub>e</sub> in a water injector, forming a solution of UO<sub>2</sub>F<sub>z</sub> in water. Treating with ammonia precipitates ammonium diuranate which is filtered out on a PVC-coated filter press. Cake may be calcined to make U<sub>2</sub>O<sub>8</sub> or reduced with hydrogen at 1,500 F. to produce UO<sub>2</sub> for enriched ceramic fuels.

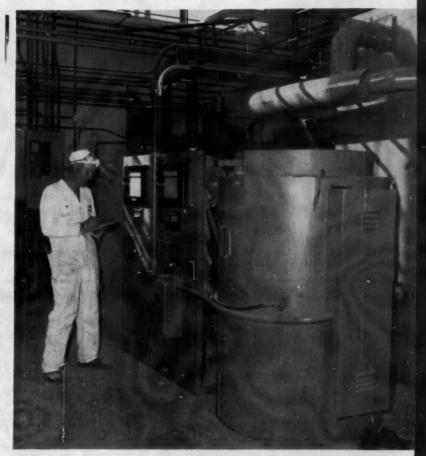


COLUMNS extract uranium from acid solution nium into water solution. Disengaging sections

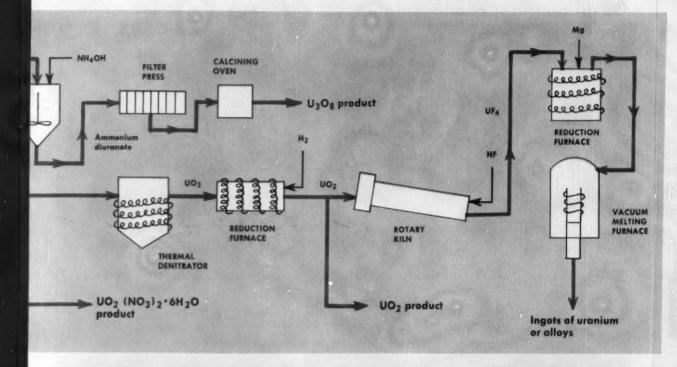


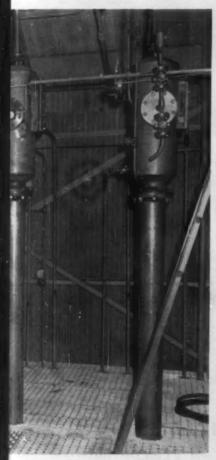


solution of ore concentrates, then re-extract urasections are fitted with interface level controls.

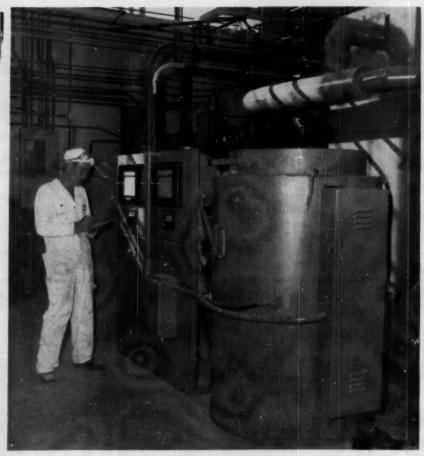


REDUCTION FURNACE heats UF<sub>1</sub>-Mg blend to 1,230 F. where reduction reaction triggered and then proceeds spontaneously. Resulting metal "derby" is cast into ingo

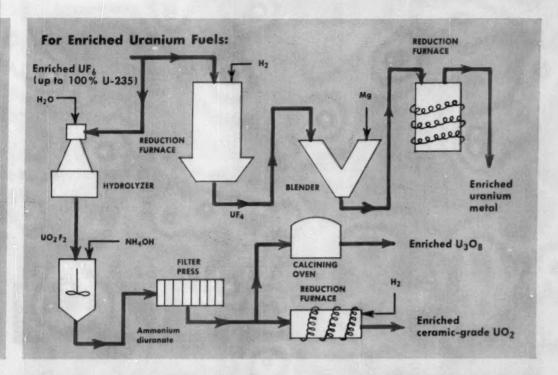




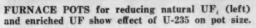
n of ore concentrates, then re-extract urans are fitted with interface level controls.



REDUCTION FURNACE heats UF<sub>4</sub>-Mg blend to 1,230 F. where reduction reaction is triggered and then proceeds spontaneously. Resulting metal "derby" is cast into ingots.

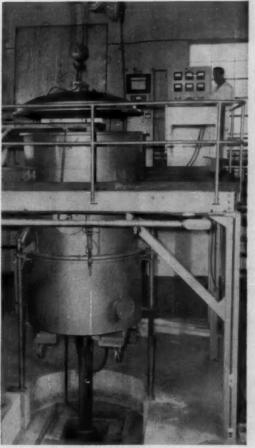




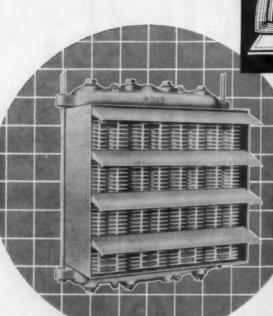


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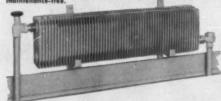
VACUUM INDUCTION FURNACE melts uranium metal derby and alloys and casts into ingots.





#### Shown In Fan Assembly

rugged, strong, and economical heat transfer surface, GRID est Heaters are designed for the tough job. - for low things steem pressures . require less labor for installonn, less cubical space, and being designed and made the me as GRID Unit Heaters are resistant to corresive elmesters. - definitely proven for years of service and continuous references.



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Designed for the tough applications in conjunction with high steam pressure systems, GRID Radiators eliminate the use of pressure reducing volves and because they are built with the same heating sections as GRID Unit Heaters, they will withstand steam pressures up to 250 P.5.1... and wide fin spacing prevents collection of dust and dirt. particularly adaptable for factory, shop offices, store rooms, laboratories, etc. ... any place where smaller heating capacities than required of a unit heater are needed.

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IN HEATING

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# Another Exacting Job for the VERTICAL MILL

Now working with industry on today's newest developments, the Raymond Vertical Mill is serving manufacturers in the production of solid rocket propellants.

Since this unit is designed for pulverizing to extreme fineness and uniformity, it does an excellent job in grinding the ammonium nitrate and ammonium perchlorate oxidizers to the required specifications.

Outstanding features of the Vertical Mill are:-

- Ability to meet exacting particle size distribution requirements for proper burning rate and molding qualities.
- Easily adjusted for a wide range of product fineness.
- Quick and complete accessibility for adjustments, clean-out or maintenance.
- Trouble-free operation with no over-heating of product.
- 5. Automatic and dust-free operation.
- 6. Compact layout and flexible installation.

One company has already been using the Raymond Vertical Mill for over two years, and has obtained excellent results on ammonium nitrate and perchlorate. Raymond mills have also been used for many years on the potassium chlorate, perchlorate, and nitrate oxidizers.



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## Chemical Engineering

## Practice

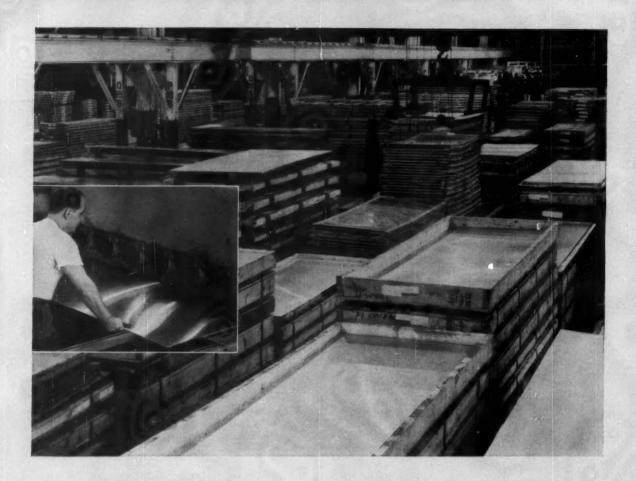
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## Chemical Engineering

OCTOBER 20, 1958

Two Ways to Solve a Problem
HOURS by SLIDE RULE by COMPUTER
To set up problem 3/4 6 Thinking
You spend calculating 630 0 m turns tal
Time left to interpret results 1/2 attimulates
8 8 erective
more time for and tation
More analysis and interpretation

Problem Solving by Computers:

## Stimulant to Creative Engineering

C. K. BUELL and L. W. POLLOCK, Phillips Petroleum Co., Bartlesville, Okla.

M ODERN electronic computers greatly contribute to the expansion of both creativity and efficiency within the process industries. Because of their tremendous speed and high accuracy, computers help to free the engineer from routine, time-consuming labor. As a result, he has more time for creative work. In addition, the fundamental approach, so essential to proper utilization of computers, promotes a line of engineering thinking that truly follows basic theoretical principles.

We may think of a computer as an extremely dependable slave who carries out commands exactly as specified, and at remarkably high speeds. Such a slave can do nothing, however, unless he first receives complete and detailed instructions covering all possible conditions and situations that he may encounter.

To properly guide this slave, the master must first analyze the proposed tasks in great detail, and evaluate all fundamental manipulations and methods thoroughly. Once this is done, and the instructions are given, the slave will carry out each assignment so rapidly that the master will be able to undertake many projects that he could not handle without the slave.

(Turn page)

#### Computers Need Guidance Too

Engineers benefit from the use of electronic computers much the same as the master benefits from his lightning-fast and dependable slave. Since computers handle calculations with such rapidity, the engineer can explore a wide range of parameters to get a better idea of the importance and significance of the variables involved. He can spend more time interpreting and analyzing the problem's results. Or, as another alternative, he can apply himself to other pressing plant problems. A computer will not, however, solve any of the engineer's problems unless the engineer first develops the methods and procedures required for proper computer operation.

Many reports such as "The Best Corn Hybrids Calculated by Electronic Computer" or "Solution of Complex Mathematical Problems Has Been Turned Over to Giant Electronic Data Processing Ma-



C. K. Buell L. W. Pollock

C. K. BUELL, as manager of Phillips Petroleum's Process Development Div., is involved in the application of electronic computers to development, design and operating problems. A graduate of Colorado School of Mines, Buell is the author of several technical publications, and holds a number of patents relating to hydrocarbon conversion processes and separation methods.

L. W. POLLOCK, manager of Phillips Petroleum's Mathematical Engineering Branch, has responsibility for developing new engineering applications for electronic computers. He has authored a number of technical articles, and holds several patents relating to petroleum and petrochemical processes. Pollock received his MS degree in chemical engineering from the University of Washington. chine" have been published in the past few years. Such stories imply that electronic computers have produced answers to not fully understood scientific problems. This implication is far from the truth.

Fundamental principles of problems that have been too large to solve without a computer need to be firmly established and well understood to develop a method of solution for a computer. The engineer is thus required to think in fundamental concepts, and to obtain a more complete theoretical understanding of his problems. Computers stimulate creative engineering.

Comparative capacities and costs of computing illustrate other benefits attainable with electronic computers. The table on the next page compares estimated relative speeds and computing costs of three electronic computers and a desk calculator. The electronic computers are typical of those used in the process industries, and include a small-scale computer (CPC), a medium-scale computer (Datatron), and one large-scale computer (IBM 709).

To promote better understanding and insight into practical engineering utilization of computers, several typical industrial applications are discussed below. In the examples presented, digital computers were actually used for solving the problems. These machines are useful in solving essentially any problem that can be expressed in mathematical terms. On the other hand, for certain problems such as those resulting in ordinary differential equations, analog computers are usually more efficient. In either case, it is usually necessary to analyze the problem to determine fundamental engineering and mathematical principles involved, and to present the variables of the problem as mathematical expressions.

#### Heat Exchanger Program

Heat exchangers must be designed, selected, and evaluated for many operations in the process industries. This design and rating has recently been programmed for a medium-size digital computer. Development of this program required a thorough evaluation of all existing design procedures and equations. Some equations were revised to eliminate discontinuities. And

new, generally applicable equations that do not degenerate at limiting conditions were developed. The analysis was much more thorough than required for design of exchangers one at a time by hand. Very complete and automatic, the general program enables thorough design or rating of all types of exchangers.

An engineer desiring specifications for a heat exchanger fills out the problem data sheet. Computer auxiliary machinery punches information from the data sheet into cards. These, along with other cards bearing calculation instructions, feed into the computer. In about 3 to 5 minutes, the machinery prints a complete summary of design specifications for the exchanger. Resultant design is closer to optimum than normally obtained by hand calculation methods.

#### Fractionators a la Computer

Usually, it is of great economic importance to achieve maximum efficiency from existing fractionators, and also to specify optimum design for new units. Computers permit design engineers to tackle these problems economically and with relative ease.

Tray-by-tray fractionator calculations, performed on a medium-size electronic computer, have assisted in pulling maximum efficiency from many existing fractionators. computer program is very flexible. It permits calculations for fractionators with multiple feeds and multiple side-draws, absorbers, absorbers with intercoolers, reboiler-absorbers, strippers, and extractive and azeotropic distillation columns. Average computer time from startup to solution for a typical fractionator problem involving one set of operating conditions is about one hour. Exploration of several sets of operating conditions, as required in the design of a new fractionator or in the analysis of an existing unit. takes only a few hours of computing time.

Fractionator economics depends primarily on operating pressure. Therefore, normal practice in fractionator design is to set an operating pressure dependent on the temperature of cooling fluid or some other parameter. Selection of this pressure is also often based on the practical experience of the design engineer.

As fractionator pressure increases, relative volatility or ease of separation will usually decrease. Decreased relative volatility requires either more reflux, more trays or both. In contrast, increased pressure permits a greater mass flow of vapor per unit of tower cross-sectional area. This tends to decrease required column diameter. Increased pressure, of course, also increases minimum requirements for thickness of the fractionator wall.

Other effects of pressure occur in the heat exchanger train related to the fractionator. Increased pressure raises the overhead vapor temperature. As a result, for a given cooling fluid, the average temperature difference in the condenser goes up, and the effective cooling surface drops.

Economic optimum operating pressure for a fractionator is a non-linear function of many variables such as those mentioned above. Although these variables are well known to design engineers, the magnitude of the problem prevented any thorough analysis and optimization until the electronic computer became available to perform the computations.

One method of calculating optimum operating pressure for fractionators on a Datatron computer is now in use. This method calculates the investment cost of equipment and also the utility cost for equipment operation. By establishing a method for balancing incremental investment cost and utility costs, the program enables the engineer using the computer to reach a decision on the most economic design. Such optimization is becoming of ever greater importance for industrial survival in an increasingly competitive market.

#### Statistical Applications Too

In the past few years, computers have been applied to the statistical analysis of experimental data. As a result of this increased emphasis on data analysis, the need for close planning of experimental programs to obtain valid conclusions regarding relationships between process variables becomes evident. Also, processes are continually becoming more complicated and involved, and product specifications more critical and rigid.

For instance, the refinery engi-

#### COMPARISON OF COMPUTING SPEEDS AND COSTS

	Relative ——Estimated Relative Cost		-Cost/Speed Ratio			
	Computing Speed	Equipment I	Labor	Total	Equipment	Total
Desk calc	1	1	25	26	1.0	26.0
IBM CPC	100	100	50	150	1.0	1.5
Datatron	2,000	500	50	550	0.250	0.275
IBM 709	60,000	2,500	150	2,650	0.042	0.044

neer in the 1930's could probably quickly determine the best operating conditions and cut points to produce the most desirable products in a batch crude-oil distillation unit. A modern catalytic process, however, requires statistical analysis of experimental data from wellplanned experiments to establish optimum conditions-those that maximize such variables as conversion, yield, product quality, product value and, ultimately, profit. Through the application of engineering and statistical fundamental principles to computer analysis of process data, a greater understanding of such process variables and their optimization can be realized.

This understanding also permits the simulation of various processes on computers. In many cases, the application of fundamental principles to processes allows postulation of the relation and interaction of process variables. Such a fundamental approach may eliminate the necessity for experimental work on certain process steps, or it may minimize the experimental work required. For involved processes, the electronic computer may help to predict results based on the postulations.

If experimental data confirm the predicted results at several conditions, other experimental tests to explore the full range of each variable may not be necessary. Postulation based on theoretical principles may require confirmation with only limited experimental data, while empirical equations for correlation of process variables will require experimental data over the entire range. Such an approach to process development can save both time and technical manpower compared to an Edisonian experimental approach. In view of the rising costs of experimental work and the increasing complexity of new processes, a high efficiency of experimental work is very desirable and necessary to obtain maximum benefits from research efforts.

#### A Look Into the Future

As larger computers with increased speed and capacity are developed, the programming and coding segments of solution become more of a bottleneck. Some computers, now in the design stage, have capacities of perhaps 100 times those of today's "giant" machines. In order to prepare problems for computers of this size, it will be of utmost importance to have efficient and fast computer compilers and other aids. These units more quickly assemble the machine language program from algebraic and general statements of the problem. For some computers now being planned for the future. preparation of machine language without benefit of a compiler would require thousands of coders per installation. This, of course, would be quite impractical. Fortunately, considerable effort has been expended on compiler systems by both computer users and manufacturers. However, in view of potential capacities of some of the future computers, efforts in developing easier methods of using them must undoubtedly be rapidly increased. This problem should justify development work similar to that devoted to other equipment improvements.

One final point deserves mention. Because of the more fundamental approach to engineering problems necessary to the increasing dependence on electronic computers, the curriculum in our engineering schools should be reviewed. Engineering courses should now be directed more toward fundamental physical, chemical and mathematical principles. Less emphasis should be given to empirical and shortcut methods of solving engineering problems. The precise and theoretical approach to problems is becoming more practical.

#### REFERENCES

1. Cozzone, F. P., NATO Advisory Group for Aeronautical Research and Development Report 130, "High Speed Computers in the Aircraft Industry."

## Solve Batch Liquid Metering Problems

MAX BASS, Project Engineer, Heyden Newport Chem. Corp., Garfield, N.J.

M EASURING liquid ingredients for a batch reaction or mixing operation is a problem you frequently come across.

When you need a high degree of accuracy, weighing or metering the ingredients into the process is generally your first answer. Initial cost and maintenance, constant necessity for recalibration and adjustment and the difficulty in automatic control, makes these two techniques undesirable in many cases.

Also, there are times when you must handle a liquid in an inert atmosphere such as nitrogen or carbon dioxide. Using a weighing or metering procedure means the added cost of venting inert gas and also an error in metering because of gas bubbles or gas solubility.

These problems are eliminated with a volumetric tank. Proper design and installation of volumetric vessels gives high accuracy—accuracy equivalent or superior to weigh tanks or meters.

In addition, reproducibility of each batch, suitability for automatic control and inherent safety that guarantees good accuracy in case of equipment failure, makes this installation a desirable solution to your measuring problems.

#### Here's How it Operates

Feed liquid is pumped from a storage tank into the volume feed-tank through valve  $V_1$ . This valve is actuated by a float-liquid-level control  $LL_2$ . When high level is reached—liquid level reaches the float center line in the 3-in. pipe riser and actually causes float movement—an air or electric signal is transmitted to valve  $V_1$ , which then shuts.

In the same way when the tank is emptied, the bottom float control  $LL_1$  is actuated at low level, closing valve  $V_{-}$ 

A three-way solenoid valve is tied into the float controls. This way the tank is vented for filling and air pressure is applied for the emptying cycle.

When the material you're handling requires an inert gas blanket, you can add a recompression tank. This method of delivery is also suited for weigh-tank installations. If you've insufficient compressed air capacity to discharge the tank, or the economics of the process justify an additional tank, then an air-recompression chamber can also be used.

Float control system is identical with the single feedtank setup. However, the operational difference is the overflow—instead of venting to the atmosphere, it's piped into the recompression tank. This compresses the gas over the entire fill cycle.

The whole sequence is controlled manually or automatically, as your process conditions require. By interlocking the float controls in the proper sequence, minimum supervision is required.

For example: you can set up the tank so it won't refill until  $LL_1$  is actuated and . . . conversely, valve  $V_1$  won't open until  $LL_2$  is actuated.

With proper indicating lights on a remote panel board, status of the process is easily followed.

#### Design a Tank for Venting to the Atmosphere

Perhaps the best way to illustrate the design of a volumetric feed-tank is by taking you step-by-step through an actual design situation. This way you'll be able to follow our design and then apply the same techniques to your problems.

We want to design a volumetric tank for operation at 86 F. with the following conditions:

- Material-40% caustic soda
- Quantity-6,000 lb.
- Specific gravity—1.423 at 86 F.; 1.416 at 104 F.
- Valve closure leg—the total time from the instant the liquid level actuates the float till the valve is actually closed. You must determine this experimentally:

Feed valve into tank  $(V_1)$ : +2 sec. (-0; +1) = +2.5 sec. average.

Discharge valve out of tank  $(V_s)$ : +4 sec. (-0; +1) = +4.5 sec. average.

- Feed rate into tank-20 gpm.
- · Discharge rate out of tank-30 gpm.
- Pressure vessel required—ASME standard, flanged and dished heads.
- Air pressure required—45 psig. will be used to blow out tank contents.
- Piping used—all schedule 80 pipe and fittings. If location of the feed tank is relatively close to the receiving vessel, base your design on completely blowing out the discharge line between the bottom float control and the receiving vessel.

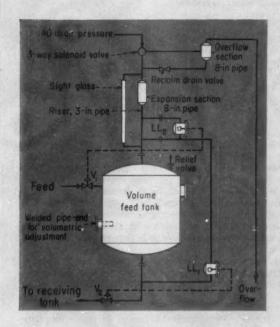
If the volume of discharge piping is greater than the volumetric quantity due to the flow rate and the valve closure lag, the line won't be entirely blown out. Only include in your calculations, the volume of material that's actually discharged into the receiving vessel in the calibration of the volumetric tank-system.

#### Step-by-Step Approach

- Step 1—Calculate overfill due to closure time-lag: feed rate (gal./sec.)  $\times$  time lag (sec.) = overfill  $(20/60) \times (2.5) = 0.833$  gal.
- Step 2—Calculate overempty due to closure time-lag: discharge (gal./sec.)  $\times$  time lag (sec.) = overempty (30/60)  $\times$  (4.5) = 2.25 gal.
- Step 3—Determine piping volume from bottom float to top float, including tank nozzles. For this example it is: 6.87 gal.
- Step 4—Calculate volume of tank heads:
  - Using a 42-in. O.D. tank,  $\frac{1}{10}$ -in. thick; 42-in. I.R. ASME head =  $2 \times 18.342 = 36.684$  gal.
- Step 5-From quantity of material and specific gravity,

## With a Volumetric Tank

Basic Design: Adaptable to Measuring Liquids in Inert Atmospheres . . .



calculate tank volume required at the operational temperature  $T_1$  of the tank.

 $(6,000)/(1.423 \times 8.33) = 506.16$  gal.

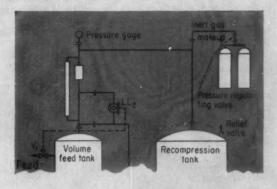
Step 6—From the diameter of the tank you've selected, figure volume per unit of height (gal./in. ht.) For a 42-in. O.D. tank, %-in. thick this is 5.81 gal./in.

Step 7—Calculate necessary height of tank. This requires a knowledge of the excess volume. Excess volume includes: overfill, overempty, piping volume and volume of tank heads. Excess volume = 46.64 gal. (tank volume — excess volume)/(gal./in. ht.) = height

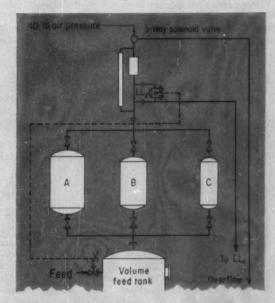
(506.16 - 46.64)/(5.81) = 79.09 in.

Construct the tank 1% larger than calculated for. This allows for variations in fabrication. Final specifications on this tank would therefore be: 42-in. O.D., %-in. thick, 6'8" straight wall height. Adjust for any added volume by inserting welded, closed, ends of pipe of the right volume through the tank nozzle. Naturally, you must do this after calibration. Calibrate the tank by filling the system with water and then discharging into a suitable drum and scale arrangement. This way you know the actual volume of the tank system.

Step 8—Calculate expansion error. If the tank contents are heated to any temperature  $T_z$  different than the



#### . . And Handling Various Volumes



design temperature  $T_i$  during its stay in the tank, total expansion is:

[(volume at  $T_1$ ) × (Sp. G. at  $T_1$ )/(Sp. G. at  $T_2$ )] – (volume at  $T_2$ ) = volume error

If the tank contents heat up to 104 F. during any undue length of holdover in the tank; total expansion is: [(506)/(1.423/1.416)] - (506) = 4 gal.

Eliminate this error by designing the volume above the top float to accommodate the expansion that occurs over the maximum variation in temperature. This increases the potential maximum error when the float doesn't operate but it also eliminates the extra attention an operator must show. With an overflow section, the expanded volume is reclaimed by opening the drain valve.

Step 9—Calculate the error from float failure: Maximum error occurs when the float doesn't work and the tank is filled to overflowing. Add an overflow chamber designed small enough to keep the error at a minimum: % Error = (volume of overflow chamber/volume of tank)  $\times$  100

By adding a 2 gal, overflow chamber our error is:  $(2/506) \times 100 = +0.4\%$ 

Step 10—Calculate error from valve closure delay: The valve closure lag is accommodated for in the excess volume calculations. However, there is a variation in this lag; given as plus or minus sec.

Fill error = feed rate  $\times$  delay Discharge error = discharge rate  $\times$  delay In this example, both valves delayed 1-sec. each. Fill error = (20/60)(+1) = +0.33 gal. Discharge error = (30/60)(+1) = +0.5 Total error = +0.83 gal.

Error =  $(0.83/506) \times 100 = +0.16\%$ Step 11—Calculate error from temperature variation. Errors from this may be negligible or appreciable, depending on the material handled and the control arrangements maintaining constant temperature.

In this case if the caustic temperature varied  $\pm$  3 F. because of control variations, the specific gravity would change  $\pm$  0.001.

Error =  $(0.001/1.423) \times 100 = \pm 0.07\%$ 

#### Design a Tank for Inert Atmospheres

Size your tank by following the same steps as outlined above. After you've got this set, determine the pressure drop anticipated between the feed tank and receiving vessel under flow conditions.

Then with the ideal gas law (at low pressures) or Van der Wall's equation at higher pressures, calculate



#### **Meet Your Author**

Max Bass is a project engineer with Heyden Newport Chemical Corp. in Garfield, N. J. Prior to this he was an assistant plant manager with Allied Chemical Corp. in Del. Max received his B.Ch.E. from City College of New York in 1951 and has done graduate work in chemical engineering at the University of Del-

aware. He is a licensed professional engineer in the State of New Jersey and a member of the North Jersey Chemical Engineer's Club. His outside interests run from photography and athletics to history...especially English and Civil War. the volume of the recompression vessel. This is all shown in the following example.

Minimum pressure required—26.7 psia. This
is based on pipeline losses at the desired flow rate, discharge head, pressure drop across control valves and
rotameters, etc.

• Volume of feed liquor—200 gal. • Temperature of feed liquor—60 F.

Final compression tank pressure—49.7 psia.
 This is sized in relation to main storage tank pressure or pump characteristics.

· Inert gas-nitrogen.

Now we'll solve for the volume of the recompression tank and piping with the ideal gas law:

Let  $V_y =$  volume of feed tank and  $V_\sigma =$  volume of compression tank and piping not filled with feed liquor. With the ideal gas law:

$$P_1(V_F + V_C) = P_2 V_C$$

Rearranging gives:

$$V_C = (P_1 V_F)/(P_2 - P_1)$$
  
 $V_C = (26.7 \times 200)/(49.7 - 26.7) = 232.1 \text{ gal.}$ 

Feed liquor is discharged into the receiving vessel between 49.7 and 26.7 psia. Nitrogen losses are continuously made up by piping a nitrogen cylinder into the compression tank. The pressure regulating valve on the cylinder is set at the low pressure of the system (26.7 psia.) so that automatic makeup occurs when the pressure drops below the regulator.

Level in the tank is indicated by a pressure gage mounted on the tank. Calibrate this gage with the gas law equations.

Accuracy in delivered quantity is the same order of magnitude as the atmospheric system. Any overflow that occurs because of equipment failure remains in the compression tank until reclaimed.

Investment in the recompression tank is easily justified by the lowered consumption of nitrogen or other inert gas used.

#### System is Versatile

With proper equipment layout, you can install auxiliary tanks on the top riser nozzle and obtain various volumes without losing any accuracy.

For example: if your process requires four different variations in feed quantity under different operating conditions, size the tanks as follows:

Say you want quantities of 500, 530, 570 and 610 gal. Size the feed tank for 500 gal. Tanks A, B and C should then have volumes of 110, 70 and 30 gal.

This system readily lends itself to automatic control. At the same time it retains the desirability of batch operation. If you want to, you can design your system to refill itself; discharge at the proper rate and time, as required by controls on the receiving vessel; and eliminate operator errors that happen with other conventional measuring systems.

Pneumatic controls simplify the installation in an area requiring explosion-proof equipment. However, there's the disadvantage of longer lag time inherent in pneumatic over electrical control. Where practical, use electrical controls because of their shorter response

In addition to the high accuracy obtained, reproducibility of delivery and reduced maintenance costs are added advantages you'll derive from this system.

## Save Time in Heat Exchanger Design

Use charts to find shellside heat transfer coefficients and to calculate shellside pressure drops in tubular exchangers.

NING HSING CHEN, Heat Transfer Div., The M. W. Kellogg Co., Jersey City, N. J.\*

THESE new charts show how to compute shellside heat transfer coefficients and pressure drops for baffled, tubular heat exchangers.

In designing a baffled, tubular heat exchanger, we must consider baffle pitch, percentage of cut-out on the baffle as well as tube size and tube arrangement. Also, leakage between the baffles and the shell, leakage between the baffle and the tube and bypassing of the flowing stream affect the design. These variables make the shellside heat transfer coefficient difficult to correlate in one equation.

However, several attempts have been made by Colburn, ' Kern, ' Donohue ' and Tinker.' Donohue's correlation \*.\* of these variables gives the most reliable equation for any type of segmental, baffled- unboredshell heat exchanger.

Donohue analyzed Tinker's and Short's experimental data "," by considering the above variables and finally obtained a single correlation. The correlation has been proved satisfactory by Katze and has been successfully applied to finned-tube heat exchanger design.

#### Computations for Heat Transfer Coefficient

Find the shellside heat transfer coefficient for a fluid at a rate of 54,100 lb./hr. flowing through a 191-in. I.D.

\*To meet your author, see Chem. Eng., June 30, 1958, p. 140.

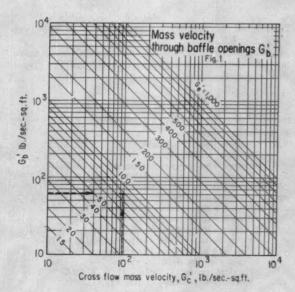
shell, containing 292 tubes each 2-in. O.D. x 16 BWG. The tubes are arranged on 15/16 in, triangular pitch with 20% baffle cut-out. Baffle spacing is 4.5 in. At the average operating temperature, the physical properties of the fluid are Z = 0.5 centipoise, C = 0.54Btu./hr.-deg. F. and k = 0.085 Btu./hr.-sq. ft.-deg.

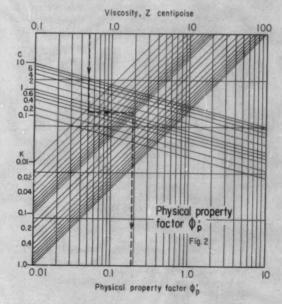
Step 1—Find the geometric mean mass velocity G. from Fig. 1. By the method of Donohue, the crossflow area equals the horizontal diameter minus the space occupied by the tubes along this diameter multiplied by the baffle spacing. For our problem, this area is (19.25  $-19 \times 0.75$ ) (4.5) = 22.5 sq. in. or 0.156 sq. ft. Hence, crossflow mass velocity is  $54,100/(0.156 \times 3,600) = 96$ lb./sec.-sq.ft.

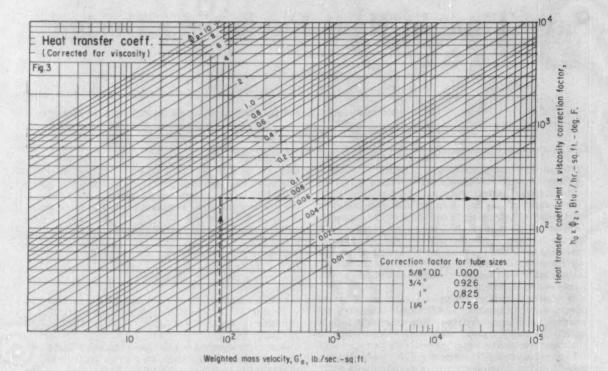
The baffle opening equals cut-out area of baffle less area of tubes passing through cut-out area. For our problem, the baffle opening is 0.24 sq. ft. Hence, mass velocity through baffle opening  $G_{b}$  is 54,100/(0.24 × 3,600) or 62.5 lb./sec.-sq. ft.

Now erect a line through G.' equals to 96 on the abscissa to meet the line drawn horizontally through  $G_0$  of 62.5 on the ordinate. The intersection gives G, equal to 77 lb./sec.-sq. ft. on the diagonal scale.

Step 2-Find the physical property factor o, from Fig. 2. Drop a line through Z = 0.5 centipoise on the top scale to meet C = 0.54. Then draw a horizontal







line to meet k = 0.085. Finally, erect a line vertically to the physical property factor which gives \$\phi\_s'\$ 0.19.

Step 3-Find the shellside heat transfer coefficient corrected for viscosity from Fig. 3. Erect a line through  $G_{\epsilon}$  as found in Step 1 to meet the physical property factor equal to 0.19. The ordinate of this intersection is read from the right scale as 200. Multiply this value by tube size correction factor of 0.926. Hence  $\phi_s h_o = 200 \times 0.926 = 185.2$  Btu./hr.-sq. ft.-deg. F.

Now let's examine the equations from which the charts were made. Donohue bases his nomograph' for the shellside heat transfer coefficient on the following

$$\frac{h_o D_o}{k} = 0.22 \left(\frac{D_o G_e}{\mu}\right)^{0.6} \left(\frac{C \mu}{k}\right)^{0.381} \left(\frac{\mu}{\mu_o}\right)^{0.14}$$
 (1)

In engineering units, we can represent Eq. (1) as:

$$\frac{h_o D_o}{k} = 0.47 \left(\frac{D_o' G_e}{Z}\right)^{0.6} \left(\frac{CZ}{k}\right)^{0.233} \left(\frac{Z}{Z_w}\right)^{0.14} \tag{2}$$

Simplifying and rearranging Eq. (2) gives:

$$\left(\frac{Z}{Z_{\#}}\right)^{-9.14} h_{*} = 64 \frac{(G_{*}')^{0.4}}{(D_{*}')^{0.4}} \left(\frac{C^{9.235}k^{0.400}}{Z^{0.367}}\right)$$
 (3)

The term  $C^{0.000}$   $k^{0.000}/Z^{0.007}$  is a function of the physical properties of the fluid. We'll call this term the physical property factor  $\phi_p$ . We now represent Eq. (3) as

$$\phi_s h_o = 64 \frac{(G_s')^{6-4}}{(D_s')^{6-4}} (\phi_p')$$
 (4)

 $\phi_{p}h_{o} = 64 \frac{(G_{o}')^{0.6}}{(D_{o}')^{0.4}} (\phi_{p}') \tag{4}$  Here  $\phi_{o} = (Z/Z_{w})^{-0.34}$  We use Eq. (4) to construct Figs. 2 and 3.

In Eq. (4),  $G_{e'}$  is defined as the geometric mean mass velocity through the baffle window G,' and the crossflow mass velocity G.

#### Nomenclature.

- C Specific heat, Btu./lb.-deg. F. Outside tube diameter, ft. D.
- Outside tube diameter, in. D. Friction factor, dimensionless.
- $G_{\circ}$ Mass velocity through baffle opening, lb./sec.-sq. ft.
- Crossflow mass velocity, lb./hr.-sq. ft. G
- $G_{\circ}$
- Crossflow mass velocity, lb./sec.-sq. ft. Geometric mean mass velocity, lb./hr.-sq. ft.
- Geometric mean mass velocity, lb./sec.-sq. ft.
- Gravitational constant, 32.2 ft./sec.3
- Heat transfer coefficient, Btu./hr.-sq. ft.-deg. F.
- Thermal conductivity, Btu./hr.-sq. ft.-deg. F.-ft.
- No Number of baffles, dimensionless.
- Number of tube rows normal to the flow.
- Baffle spacing, ft.

- Baffle spacing, in.
- S.G. Specific gravity of fluid.
- Velocity of fluid, fps.
- Viscosity at average temperature, centipoise.
  - Viscosity at tube wall temperature, centipoise.
- Head loss due to friction, ft.  $\Delta h$
- Pressure drop through baffle opening, psi. AD'
- Pressure drop across tube bundle, lb./sq. ft.  $\Delta p_o$
- $\Delta_{o}'$ Pressure drop across tube bundle, psi.
- Ap. Pressure drop through shell, psi. Viscosity at average temperature, lb./hr.-ft.
- Viscosity at tube wall temperature, lb./hr.-ft.
- Density of the fluid, lb./cu. ft.
  Physical property factor, Co. according to ko. occ /Z. c. see
- Viscosity correction factor, (Z/Zw).-0.14

 $G_{a'} = (G_{b'}G_{a'})^{0.5}$ 

We use Eq. (5) to construct Fig. 1.

#### Find Shellside Pressure Drop

For shellside pressure drop calculations, it is better to calculate the sum of the pressure drop across the tube bundle and the pressure drop through the baffle opening. This method has been described by Drew and Genereaux, Donohue and Katz.

Let us solve a problem to demonstrate the use of the charts which give us an accurate and fast solution for

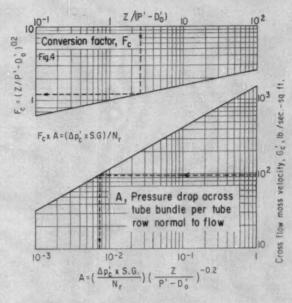
pressure drop.

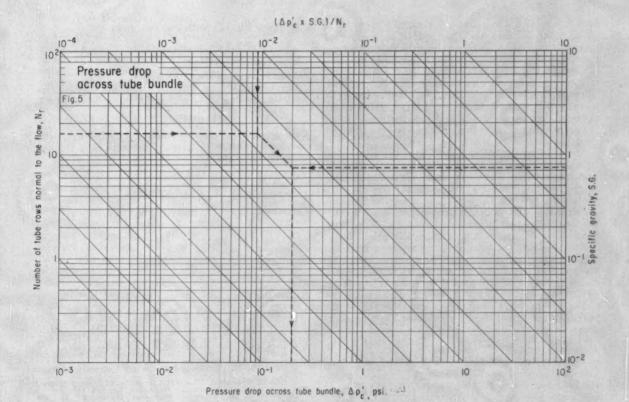
Find the pressure drop through the shell for a fluid at a rate of 54,100 lb./hr. flowing through a  $19\frac{1}{2}$ -in. shell having 292 tubes each  $\frac{3}{2}$ -in.  $\times$  16 BWG. The tubes are arranged on  $\frac{1}{2}$ -in. triangular pitch with a 20% baffle cut-out. Baffle spacing is 4.5 in. At the average operating temperature, the properties of the fluid are: specific gravity is 0.74 and viscosity Z is 0.5 centipoise.

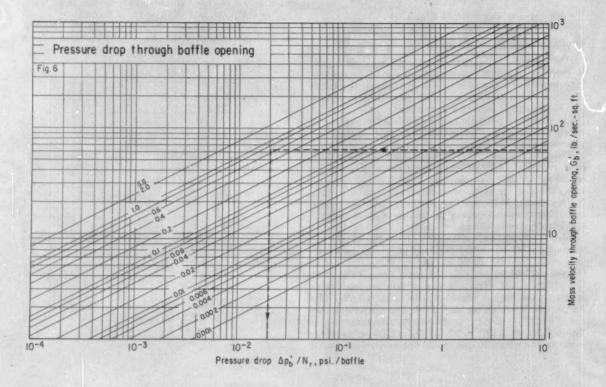
Step 1—Find  $(\Delta p_e' \times S.G.)/N$ , from Fig. 4. By the method explained in the previous problem, the crossflow mass velocity is 96 lb./sec.-sq. ft. Draw a line through  $G_e'$  of 96 on the right hand ordinate to meet the straight line. The abscissa of this intersection is given on the bottom scale as  $[(\Delta p_e' \times S.G.)/N_e]$   $[Z/(P'-D')]^{0.3}$  which equals 0.0076. The conversion factor  $[Z/(P'-D')]^{0.3}$  is found by dropping a line through Z/(P'-D') = 0.5/0.1875 = 2.66 on the upper scale to the straight line. Read the conversion factor

(5) which is 1.2 on the ordinate scale to the left. Then  $(\Delta p_c^2 \times S.G.)/N_r = 0.0076 \times 1.2 = 0.0092$ . Step 2—Find  $\Delta p_c^2$  per shell from Fig. 5. Erect a

Step 2—Find  $\Delta p_e'$  per shell from Fig. 5. Erect a line through  $(\Delta p_e' \times S.G.)/N_e = 0.0092$  as found from







Step 1 to meet the line drawn horizontally from  $N_r$  = 16 as found by Donohue's method. The number of tubes rows crossed N, is taken along the flow path from the center of one baffle cut-out to the center of the next.

Through the above intersection, draw a line at 45° to meet the line drawn horizontally from S.G. of 0.74. Through this last intersection, erect a line vertically to the lower scale. Read  $\Delta p_e' = 0.2$  psi. which is the pressure drop across the tube bundle per cross. Since the exchanger has 38 baffles or 39 crosses, the pressure drop per shell is  $39 \times 0.2 = 7.8$  psi.

Step 3-Find Ap,' from Fig. 6. Find the mass velocity through the baffle opening  $G_{\bullet}$  as explained in the previous example. For this problem G, is 62.5 lb./sec.sq. ft. and the number of baffles is 38. Draw a horizontal line through  $G_{0}' = 62.5$  to meet the S.G. line which is 0.74. Through this intersection, draw a vertical line to the bottom scale and read  $\Delta p_{s}'/N_{s} = 0.02$ . Since  $N_b = 38$ ,  $\Delta p_b' = 0.02 \times 38 = 0.76$  psi.

Step 4-Find the total shellside pressure drop  $\Delta p'$ which equals  $(\Delta p_o' + \Delta p_b') \times \text{safety factor.}$  Substitute the value of  $\Delta p$ , found in Step 2 of 7.8 psi. and  $\Delta p$ , found in Step 3 of 0.76 psi. If we use a safety factor of 1.2, then  $\Delta p_i' = (7.8 + 0.76) \ 1.2 = 10.3 \ psi.$ 

For the pressure drop across the tube bundle, the variables are correlated by a modified Fanning equation.

$$\Delta p_{\bullet}' = 2fN_{\tau}(G_{\bullet}')^{2}/g\rho \tag{6}$$

For turbulent flow, the friction factor f is

$$f = \frac{0.75}{\left(\frac{P - D_{\phi}}{D_{\phi}}\right)^{62} \left(\frac{D_{\phi}G_{\phi}'}{\mu}\right)^{6\cdot2}} \tag{7}$$

Combining Eq. (7) with Eq. (6) gives

$$\frac{\Delta p_{e'} \times S.G.}{N_r} = \frac{1.98}{10^8} (G_{e'})^{1.8} \left(\frac{Z}{P' - D_{e'}}\right)^{8.2}$$
(8)

We use Eq. (8) to construct Fig. 4.

For pressure drop through the baffle opening, we treat the opening as an orifice with a coefficient of 0.7.

$$V = 0.7(2g \Delta h)^{0.5} \tag{9}$$

Expressing V in terms of mass velocity through baffle opening  $G_{b}$  and  $\Delta h$  in terms of pressure drop through baffle opening  $\Delta p_{s}'$ , we get the equations:

$$V = G_b'/(62.4 \times S.G.)$$
 (10)

$$\Delta h = 144 \, \Delta p_b' / (62.4 \times S.G.)$$
 (11)

Combining Eqs. (10) and (11) into Eq. (9) gives

$$\Delta p_{b'} = \frac{3.54 (G_{b'})^3}{10^6 \, S.G.} \tag{12}$$

We use Eq. (12) to construct Fig. 6.

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## How T and P Change Gas Viscosity

Today's best engineering methods for calculating the effect of temperature and pressure variation on the viscosity of a gas.

Wallace R. Gambill, Union Carbide Nuclear Co., Oak Ridge, Tenn.\*

T LOW or moderate pressures, the viscosities of gases-unlike those of liquids-increase with temperature increase. However, at high densities the mechanism of gas viscosity becomes increasingly similar to that of liquid viscosity: and the point is reached where gas viscosity is inversely proportional to temperature, as is the case for liquids.

We will consider here the temperature dependence of gas viscosity at low or moderate densities, where  $\mu_{\theta}$  rises with T.

#### When You Have One Point

For the case where  $\mu_a$  is known only at a single temperature and values at other temperatures are desired, the temperature dependence may be estimated from any of Eqs. (3) through (15) and from those in Table III of our previous article (Chem. Eng., Sept. 22, 1958, p. 169).

Arnold's relation, for example, shows  $\mu_s \propto T^{1.5}/(T+1.47T_s)$ ; Licht & Stechert's equation shows μ,° α  $T^{1.5}/(T+0.8T_c)$ ; an equation by Johnson, et al., shows  $\mu_* \propto T^{0.786}$ ; and Falkovskii's equation shows  $\mu_s^{\circ} \propto T$ .

The equations of Arnold and of Licht & Stechert are related to the accurate Sutherland form of temperature dependency, which we'll discuss later. For the present case (where only one  $\mu$ , value is known), however, it's best to calculate µ, at other temperatures by using the viscosity relations of Hirschfelder, et al.44, or their various modifica-

According to Eq. (3),  $\mu$ ,  $\alpha T^{0.5}/\phi_{\nu}$ ,

$$\frac{\mu_2}{\mu_1} = \left(\frac{T_2}{T_1}\right)^{6.5} \left[\frac{(\phi_V)_1}{(\phi_V)_2}\right]$$
 (16)

\* To meet your author see Chem. Eng., Feb. 10, 1958, p. 173.

where or can be obtained from Table I, based on e/k values from Table II, or estimated from Eqs. (6) or (13).

Similarly, Bromley & Wilke's Eqs. (8) and (9) indicate that  $\mu_{\pi}^{\circ} \propto$  $[f(kT/\epsilon)]$ , so that:

 $\mu_2/\mu_1 = f(kT_2/\epsilon)/f(kT_1/\epsilon)$  (17) The function  $[f(kT/\epsilon)]$  may be obtained from Eq. (10) if e/k is known from µ, data, or approximated by Eq. (11) if  $\epsilon/k$  is unknown.

#### With Two or More Values

For the case where you want to interpolate and extrapolate two or more values of viscosity, other procedures are more desirable.

Licht & Stechert made an extensive study of the variation of gas and vapor viscosity with temperature, reviewing four of the most promising simple (two-constant) temperature functions: those of Sutherland," Reinganum" and Trautz<sup>®</sup>; and the "exponential" form  $(\mu = aT^n)$ . Their comparison, based on 26 gases over wide temperature ranges, indicated that for a large majority of gases the Sutherland equation,

 $\mu_e^{\circ} = KT^{1.5}/(T+S)$ 

is easily the most satisfactory. Including H, and He (for which only the Trautz relation was accurate), the over-all average error associated with Eq. (18) was 1.3%; excluding H, and He it was only 0.8%. These error figures represent the deviation of viscosity values calculated from the equation of the best line through the original (unsmoothed) experimental data points, as compared with the same data; i.e., they represent errors in overall data representation by the four

Eq. (18) may be written so as to show that a rectangular-coordinates plot of  $(T^{1.5}/\mu_g^s)$  vs. T should give a straight line. Such a plot is the procedure recommended here for multivalue data representation.

The simple "exponential" form,

$$\mu_{\theta}^{\circ} = aT^{*}$$
 (19)  
to be fairly accurate.

also proved to be fairly accurate. Over-all avg. error including H, and He is 1.8%; excluding them it is 1.7%.

Hirschfelder, Bird & Spotz" have determined the functional dependencies of (S/T), Eq. (18), and of n in Eq. (19) on their  $kT/\epsilon$  in such a way that Eqs. (18) and (19) are "forced" to agree with their Eq. (3). Ref. 31 presents a table and

#### Nomenclature.

Viscosity covolume (volume of molecules), cc./gram.

A molecular parameter, see Eq. Functional dependence

Viscosity-constitutional constant. Boltzmann's constant, ergs/deg.

Molecular weight. Avogadro's number.

Absolute pressure, atm. Universal gas constant. Sutherland's constant.

Absolute temperature, deg. K. Molar gas volume, cc./gram-mole. Molecular-collision probability

factor. Gas-phase mole fraction. Compressibility factor.

Maximum energy of molecular attraction, ergs.
Gas viscosity, micropoises.

Gas density.

Molecular diameter, Angstrom

Collision function for gas vis-

#### Constants

a, A, b, B, C, D, E, K, n

At the normal boiling point. At the critical point. Reduced property.

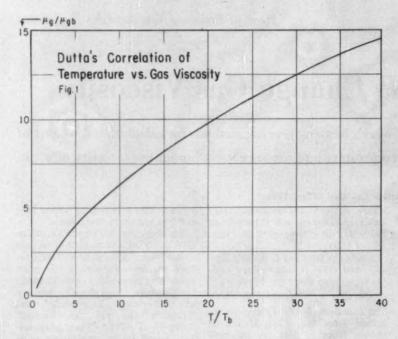


chart of S/T and n as a function of  $kT/\epsilon$ . Their conclusion that Eqs. (18) and (19) are not accurate over "large" temperature ranges is not supported by Licht & Stechert's study, though part of the contention is probably associated with the question of how broad a temperature range is "large."

Over a very wide span of temperature, the temperature dependence given by Eq. (16)—from Eq. (3)—is doubtless the more accurate.

A brief discussion of the n vs.  $kT/\epsilon$  values of Hirshfelder, et al., may be found in the paper by Craven & Lambert," in connection with their experimental data for 11 organic vapors, for which they found  $\mu = bT$  for the small temperature range of 35-78 C.

More complicated functions of  $\mu_s$  vs. T have been proposed; four of these were reviewed briefly by Licht & Stechert." The best allaround, three-constant function appears to be Keyes' modified Sutherland equation:

$$\mu_{g^{\circ}} = \frac{A \, T^{\circ.5}}{1 + (B/T) 10^{-C/T}}$$
 (20)

#### Some Other Relations

Though the methods discussed above are those that we recommend

for use, we'll mention five others as a matter of interest.

Dutta<sup>ss</sup> suggested the use of this relation:

$$\frac{\mu_{\theta}}{\mu_{\theta b}} = \frac{1}{(T/T_b)^{6.5} \exp \left[1 - \frac{1}{(T/T_b)^{6.5}}\right]}$$
 (21)

Eq. (21) has been plotted as Fig. 1. Dutta found that the data fit was good for seven low-boiling "permanent gases" as well as for a number of organic vapors.

Smith & Brown<sup>ss</sup> showed that a plot of  $\log (\mu/M^{\circ.5})$  is a linear function of  $\log T$ , for gases and vapors at low pressure, but that the straight line should not be extrapolated to  $T_b$ , near which curvature begins. For saturated hydrocarbon vapors, Smith & Brown presented plots of  $\mu P_r/M^{\circ.5}$  vs.  $T_r$ . For alcohols they had to use  $\mu P_r/F^{\circ.5}$ . Reduced pressure,  $P_r$ , entered into the corre-

#### For Sutherland's Constant

Proponent	Equation	Ref.
Vogel	$S = 1.47 T_t$	16
Licht and	$S = 0.80 T_e$	17
Stechert	148 A	
Whilley	$S = 0.84 T_c$	22
Rankine	$S = 0.885 \ T_c$	37
Fisher	$S = 0.058 M^3 + 74$	38

lation since P changes with T for a saturated fluid. (The viscosity constant, I, will be discussed in the section on viscosity of liquids to appear in an early issue.)

#### Reference-Substance Plots

Othmer & Josefowitz<sup>10</sup> proposed another reference-substance type relation for correlating  $\mu$ , with both T and P. The isobaric correlation is equivalent to:

$$\log \mu_{\rm g} = A \log P_{\rm V} + B \qquad (22)$$

where A and B are constants; and  $P_r$  is the vapor pressure at the temperature of the reference substance.

Andrussow and Brancker have also considered the temperature dependence of gas viscosity, but their proposed formulae do not appear to possess any advantages over those discussed above.

#### To Estimate S Values

A number of correlations discussed in this series have involved the Sutherland constant, S. This constant is properly evaluated from data on the variation of gas viscosity with temperature, but a number of estimation methods for S have been proposed. We have listed five of these methods in the accompanying table. Methods are listed in the approximate order of their validity.

We have used Vogel's equation consistently because it has been shown to be reliable through considerable testing, especially that done by Arnold."

In some correlations in which S appears, the accuracy of the quantity calculated is not affected much by variations in S, so that it isn't important to know S values very accurately.

For binary mixtures, early proposals<sup>20</sup> for the Sutherland constant,  $S_{1.3}$ , included those of Jung & Schmick:

$$S_{1,2} = 0.733 (S_1S_2)^{0.5}$$

and of Schröer:

$$S_{1, 2} = 0.950 (S_1S_2)^{0.5}$$

More recent studies (by Lindsay & Bromley, e.g.) have shown that, for nonpolar mixtures,

$$S_{1, 3} = (S_1 S_2)^{0.5}$$

is satisfactory; when one component is highly polar, you can use

$$S_{1,2} = 0.735 (S_1S_2)^{0.5}$$

Note that the constants of these

later proposals are quite close to those of the earlier ones.

#### Pressure vs. Gas Viscosity

For the pressure range from a few mm. of Hg to several atm. (usually 5-30 atm.), the viscosity of a gas is essentially independent of pressure, as predicted by classical kinetic theory.

At lower pressures (below about 1-10 mm. Hg), the mean free path of the gas molecules may become significant in comparison to test cell or equipment dimensions; and due to "slip" at the boundaries, the apparent viscosity decreases. At higher pressures, on the other hand,  $\mu_{\theta}$  increases with pressure.

At high pressures (usually in the 100-1,000 atm. range) and densities, the temperature dependence of  $\mu_s$  inverts and the temperature coefficient becomes negative.

These trends of  $\mu_{\tau}$  with P and T are well illustrated in Fig. 2, which we have adapted from Hamann's book. We can see that the magnitude of the pressure effect is smaller at higher temperatures.

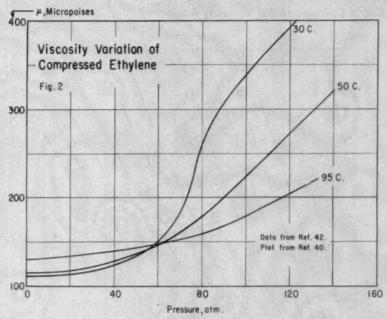
Now let's consider the several methods available to the engineer for estimating  $\mu_g$  pressure dependence.

#### **Use Reduced Variables**

Most convenient correlations for pressure dependence are those in which the "viscosity ratio"  $\mu_P/\mu_1$  is related graphically to  $T_r$  and  $P_r$ , as first proposed by Comings & Egly." In this ratio,  $\mu_P$  is gas viscosity at some elevated pressure and  $\mu_1$  represents gas viscosity at the same temperature but at a low pressure, small enough for  $\mu_r$  to be independent of pressure (at 1 atm. abs., e. g.).

In the original presentation, it was shown that for  $T_r$  and  $P_r > 1$ , agreement was good (10-20%), but that for  $P_r$  and  $T_r < 1$ , correlation was not so good. Comings & Egly later reported some additional data which generally confirmed the earlier correlation. A revised chart showing a somewhat smaller effect of pressure—but generally more accurate and complete—was published by these same researchers in 1944 and 1945.

Uyehara & Watson \*\*.\*\* proposed a different type of plot, one of  $\mu_r = \mu/\mu_e$  vs.  $T_r$  and  $P_r$  (see Chem. Eng., Sept. 22, 1958, p. 171, Table IV for



details). Though this type of plot has certain features not shared by a  $\mu_P/\mu_1$  chart, it is not as convenient since  $\mu_1$  values are more generally available than values of  $\mu_r$ . For this reason, the Uyehara-Watson chart was replotted as  $\mu_P/\mu_1$  vs. T, and P, by Bromley & Wilke, and used by Rubin in his discussion of hydrogen-mixture properties.

For more consistent interpolation, Scheibel" presented a nomograph of the Bromley-Wilke chart which supposedly reproduces its curves except in the immediate region of the critical point. A comparison made by Johnson" for five pure gases at 18 conditions of temperature and pressure showed the Comings chart. to be somewhat more accurate in predicting pressure dependence than the Uyehara-Watson chart.

A plot based on the same general principles was presented by Smith & Brown,<sup>35</sup> in which  $\log (\mu/M^{0.5})$  vs.  $T_r$  and  $P_r$  was plotted for two chemical classes: diatomic gases and n-paraffin vapors.

#### Best of This Type

However, the best all-around correlations of this type appear to be those of Carr & coworkers\*\*, and of Grunberg & Nissan.\*\*

Carr's generalized correlation,

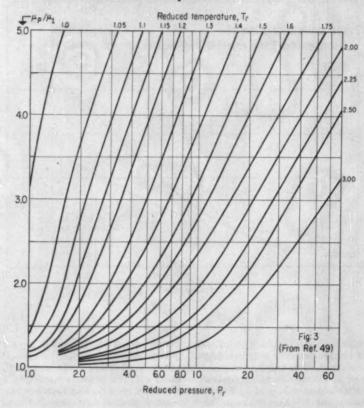
given here as Figs. 3 and 4, agrees well with the earlier Comings' curves in overlapping ranges of T, and  $P_{\rm e}$ , and in higher ranges ( $P_{\rm e}$  > 10) gives considerably better agreement with newer experimental data for high-pressure gases and gas mixtures than the Uyehara-Watson plot. The charts by Carr and his coworkers are based on their own data for CH, and for three gas mixtures, as well as five earlier sets of high-pressure data.

Average and maximum deviations of 1.5% and 8.0% are claimed. The maximum error occurred for a natural gas at  $P_r = 15$  and  $T_r \cong 1.5$ . Fig. 3 is also reproduced in Comings' new book, with the addition of curves for  $T_r = 0.8$  and 0.9 (mislabeled 0.08 and 0.09 in the book). However, these curves for  $T_r < 1$  are in the region of largest deviations when  $P_r > 1$ .

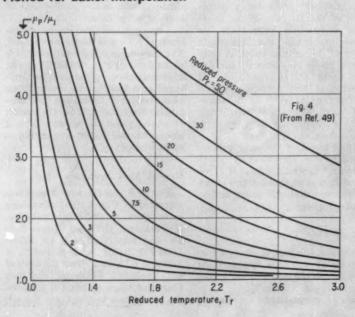
#### Replot Aids Accuracy

You may wonder why Fig. 3 was replotted as Fig. 4. The advantage is in more accurate interpolation. For example, if  $T_r$  is 1.67 and  $P_r$  is 23, one may read  $(\mu_P/\mu_1)$  values from Fig. 3 at  $P_r=23$  and at  $T_r=1.60$  and 1.75, straddling the desired but unplotted isotherm. We may then plot these points (of  $\mu_P/\mu_2$  vs.  $T_r$ ) on Fig. 4 to construct the de-

#### Carr's Correlation for Viscosity Ratio



#### **Plotted for Easier Interpolation**



sired isobar for  $P_r=23$ , from which  $\mu_P/\mu_1$  at  $T_r=1.67$  may be read.

The increased accuracy resulting from such a procedure is significant in certain ranges of the charts.

Fig. 5 is a recent extension of the Carr correlation to much larger values of  $T_r$  and  $P_r$ , based on data for He, H<sub>2</sub> and D<sub>2</sub> (for which  $P_o$  and  $T_c$  are small). Note that Fig. 5 has been plotted with  $\mu_F/\mu_1$  as parametric curves, which clearly shows that  $\mu_F/\mu_1$  may be small even at large  $P_r$  if  $T_r$  is also large. At 800 times the critical pressure, e.g., the viscosity is only 1% greater than that at atmospheric pressure if  $T_r = 300$ .

#### In the Critical Region

To make interpolation in the critical region more reliable, Grunberg & Nissan<sup>20</sup> plotted  $\mu_P/\mu_1$  vs.  $T_r$  and  $\rho_r$ , the reduced density. Though probably the best method for estimating gas viscosities in the critical region, the advantages of the Grunberg-Nissan correlation are diminished by a relative lack of critical density or volume data.

 $V_c$  (or  $\rho_e$ ) may be estimated within 2-3%, however, as we will discuss in the section of this series dealing with critical properties. The Grunberg-Nissan nomograph is given here as Fig. 6.

In the authors' comparison of their nomograph with experimental results for seven gases under 116 conditions (a few were liquids near the critical point), over-all average and maximum errors of 7.5% and 24% were found. The bulk of the data was represented within  $\pm 10\%$ .

In Fig. 6,  $\mu_1$  is, once more, the viscosity of the gas or vapor at moderate (atmospheric) pressure, but  $\mu_F$  may in this case be the viscosity of the compressed gas or of the liquid near the critical point, at the same temperature. Fig. 6 is recommended for lower values of reduced pressure, and especially in the region of the critical point, if good values for  $V_c$  are known or calculable.

#### Enskog's Dense Gas Theory

For the simplest case of a gas of rigid, spherical, nonattracting molecules, Enskog<sup>2,4,9</sup> has developed a kinetic theory of dense gases. More rigorous theories for dense gases (and liquids) have been attempted

& Green.54

A "rigid sphere" gas of the type considered by Enskog follows the virial equation of state:

$$\frac{PV}{RT} = z = 1 + \frac{B}{V} + \frac{C}{V^2} + \frac{D}{V^3} + \frac{E}{V^4} + \cdots (23)$$

where the virial coefficients are given by:4

$$\begin{array}{c} B = b_o = \frac{2}{3} \pi \ N \ \sigma^3 \\ C = 0.6250 \ b_o^3 \\ D = 0.2869 \ b_o^3 \\ E = 0.115 \ b_o^4 \end{array} \right\} \ (24)$$

And if,

$$y = \frac{PV}{RT} - 1 = z - 1 \tag{25}$$

then,

$$y = \frac{b_o}{V} + 0.6250 \left(\frac{b_o}{V}\right)^2 + 0.2869 \left(\frac{b_o}{V}\right)^3 + 0.115 \left(\frac{b_o}{V}\right)^4$$
(26)

at low or moderate densities.

Enskog's result for  $\mu_P/\mu_1$  in terms of the y of Eq. (26) was:

$$\frac{\mu_P}{\mu_1} = \frac{b_0}{V} \left[ \frac{1}{t} + 0.8 + 0.761 y \right] \quad (27)$$

where  $b_{\bullet} = 0.67 \pi N \sigma^{*}$ ; V is molar gas volume; and  $\sigma = \text{molecular dia}$ .

#### Theory Checks Actual

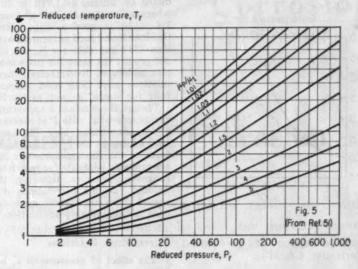
Despite the crudeness of the model, Eqs. (26) and (27) fit  $\mu_P$  data for argon at 0 C. fairly well up to 200 atm. (see Fig. 7). Argon, of course, fits the assumptions of the development much better than the molecules of most other real gases. Enskog suggested that for real gases, pressure, P, in Eq. (25) be replaced by the "thermal pressure," resulting in:

$$y = \frac{M}{R\rho} \left( \frac{\partial P}{\partial T} \right)_{V} - 1 \qquad (28)$$

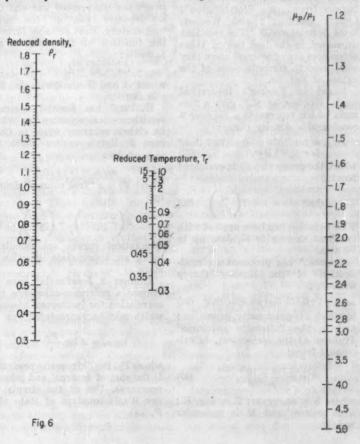
and also that  $\sigma$  (or  $b_{\bullet}$ ) be evaluated from the data at the point where  $(\mu_P/\mu_1)$  V as a function of y is at a minimum.

With these modifications (which require some  $\mu_P$  data as well as P-V-T data), the viscosity of N<sub>2</sub> to 966 atm. and of CO, to 115 atm. have been well represented by the Enskog equations. At still higher densities, this method tends to overestimate μ. Actual use of the equations in the above form, with Eq. (28), is complicated by the requirement of very precise P-V-T data for accu-

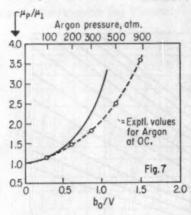
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#### **Especially Good for the Critical Region**



#### Theory vs. Actual



rate evaluation of the partial derivative,  $(\partial_P/\partial T)_T$ .

#### For Further Discussions

Further discussions of applications of this approach to viscosity calculation may be found in Comings<sup>®</sup>; Comings & Nathan<sup>®</sup>; Colburn, Drew & Worthington<sup>®</sup>; Lype<sup>®</sup>; Gardner<sup>®</sup>; and Woolley, Scott & Brickwedde.<sup>®</sup> The relations expressed in the last two of these references are of interest since they were used to compute some of the values of Ref. 59.

Based on Enskog's theoretical work, Woolley, et al., so give a formula which represents  $\mu_F/\mu_1$  over a considerable density range:

$$\mu_P/\mu_1 = 1 + 0.175 (b\rho x) + 0.7557 (b\rho x)^4 - 0.405 (b\rho x)^3$$
 (29)

where the group  $(b \rho x)$  is evaluated from:

$$(b\rho x) = x - 1 + T\left(\frac{dx}{dT}\right) \quad (30)$$

This equation has been applied with excellent success to H<sub>2</sub> data up to 70 atm.

Gardner has proposed a simplification of the Enskog theory whereby:

 $\mu_P/\mu_1 = 1 + 0.175 \ (b_P) + 0.8651 \ (b_P)^2 \ (31)$  in which  $\rho$  is gas density, grams/cc.; and b, the "viscosity covolume" (volume of the molecules), is calculated from:

$$b = \frac{1.783 \times 10^{-7} \ T^{0.75}}{\mu_1^{1.6} \ M^{0.25}}$$
 (32)

where b=cc./gram; T=deg. K.;  $\mu=\text{poises}$ ; and M is molecular weight.

The constant of Eq. (32) as predicted by Enskog is  $1.872 \times 10^{-8}$ , whereas Comings & Nathan<sup>54</sup> found  $1.4 \times 10^{-8}$  a good average value. Gardner found good agreement with Eqs. (31) and (32) for N<sub>8</sub>, but did not predict the same for more complex molecules. Nevertheless, these relations have been used successfully for steam<sup>56</sup> as well as for N<sub>8</sub>.

Though the constant b apparently varies somewhat with P at constant T for some gases, Eqs. (31) and (32) represent the most convenient form of the Enskog approach and are probably adequate for restricted ranges of pressure. However, the reduced variable correlations discussed above are the recommended ones for engineering application.

#### Three More Relations

The effect of pressure on  $\mu_s$  has also been correlated successfully (in the fitting of experimental data) by the form:

$$(\mu_P - \mu_1) = f(\rho)$$
 (33)

where  $(\mu_P - \mu_1)$  is the "residual viscosity" or difference of  $\mu$  between the compressed gas and the low-pressure gas at the same temperature. Most suitable form of the function of Eq. (33) is apparently:

$$(\mu_P - \mu_I) = A(10^{bp} - 1)$$
 (34)

where A and B are constants; and  $\rho$  is density.

Hulburt<sup>60</sup> has derived a simple semitheoretical equation for which he claims accuracy equal to Comings & Egly's earlier chart for  $\mu_P/\mu_1 < 1.6$ :

$$\mu_P/\mu_I = (V/V_f)^{0.067}$$
 (35)

where  $V_i$  is a "free volume" defined by:

$$R\left(\frac{\partial \ln V_f}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V \quad (36)$$

Theoretical curves are calculated using an appropriate equation of state.

Othmer & Josefowitz<sup>34</sup> have developed a reference-substance type correlation for isothermal viscosity which may be represented by:

$$\log \mu_{\theta} = A \log \frac{P_K}{\rho} + B \qquad (37)$$

where  $P_{\kappa}$ , the "kinematic pressure," is the sum of external and cohesive pressures. Use of the simple van der Waals equation of state gives  $P_{\kappa}$  as:

$$P_K = P + (a/V^*) \tag{38}$$

A log-log plot of  $\mu_z$  vs.  $(P_z/\rho)$  shows good linearity for several gases.

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## Corrosion

REFRESHER ON CAUSE AND CURE

## **Protective Coatings Limit Corrosion**

- · Why surface preparation is essential for stability of coatings
- · How to select the most suitable finish for the environment

ROBERT V. JELINEK, Syracuse University, Syracuse, N. Y.\*

When environment modification is not sufficiently effective or can not be applied in a particular system, corrosion control may be achieved by using protective coatings or more resistant materials of construction.

Limitations imposed by cost and fabrication requirements often rule out the material with the most desirable corrosion resistance. Therefore, a protective coating on a less resistant metal or alloy represents a practical compromise in the chemical industry.

Many different coatings are used commercially. There are three general categories of coatings, metallic, inorganic and organic. These are further subdivided according to composition and method of application.

In recent years there have been many developments in corrosion resistant materials of interest to the chemical engineer. We shall discuss these later. First let us consider some of the basic principles and practices in the use of protective coatings.

#### Surface Preparation Is Essential

As a general rule, the quality of a coating is no better than that of the surface to which it is applied. The most important requirement is surface cleanliness. The presence of grease, oil, dirt or scale—practically unavoidable in the

handling and fabrication of metals—adversely affects the adherence, continuity and general durability of coatings.

Cleanliness requirements are most stringent in electroplating and somewhat less so in painting. However, the same principles apply to all coating processes. Cleaning techniques and criteria of cleanliness have received considerable attention in the literature by Burns and Bradley' and by Lux and Linford\* who give excellent reviews of this field.

Metal surface preparation processes usually consist of two steps which are degreasing and descaling. The oldest and most prevalent methods of degreasing uses alkalies. A large variety of proprietary compounds are marketed for this purpose. These usually consist of caustic soda, soda ash, phosphates and alkali silicates in various proportions plus soap or synthetic detergents to decrease surface tension and aid emulsification. Most commercial cleaners' have pH values about 11 to 11.5 and are buffered for greater uniformity of action.

More concentrated, more alkaline and hotter solutions can be used on ferrous metals than on non-ferrous metals. Copper, zinc, tin, aluminum, lead and their alloys are apt to pit or tarnish in alkaline cleaners unless inhibitors are present. Articles or surfaces to be cleaned may be dipped into or sprayed with the alkaline bath.

Spraying gives somewhat better cleaning because of simultaneous mechanical action.

Alkali cleaners may also be operated electrolytically. The work is usually made the cathode at high current density. Vigorous hydrogen gas evolution agitates the bath and aids emulsification of oils and greases. A certain degree of descaling is also accomplished during cathodic cleaning which is generally more rapid than soaking or spraying. When hydrogen embrittlement is undesirable, anodic cleaning may be used.

Solvent degreasing has become quite popular in recent years. Most widely used as solvents are chlorinated hydrocarbons-usually trichlorethylene containing a stabilizer. Although nonflammable and boiling at relatively low temperatures, these materials are toxic and require appropriate personnel Vapor desafety precautions. greasing is the usual application technique. Totally enclosed equipment boils the solvent and allows clean vapors to condense on the work, thus carrying off grease and dirt in the collected liquid which is purified and recycled.

While highly effective in removing large quantities of oil and grease, solvent cleaning does not remove soap or water-soluble impurities. Also solvent cleaning does not produce the high degree of cleanliness required for electroplating. Accordingly, it is best as an initial step for heavily soiled

<sup>\*</sup>To meet your author, see Chem. Eng., July 28, 1958, p. 161.

articles. After solvent cleaning, the article is given an alkali cleaning and water rinse.

Descaling may be accomplished by acid pickling, mechanical abrasion or a combination of the two operations. Severity of treatment depends on the thickness and composition of oxide or other corrosion products which are determined by heat-treatment history and previous processing. Ordinary chemical pickling is immersion of the metal in dilute (5 to 10%) sulfuric or hydrochloric acid for 5 to 20 min. at 150 to 200 F. A cathodic inhibitor in the acid bath minimizes metal solution and hydrogen embrittlement.

Many formulations1,6 employing different acids are suggested in the literature. Electrolytic pickling may be used to increase descaling rate by employing more concentrated acids and high current densities. Anodic, cathodic and alternating current treatments have been prescribed for various situations but they have not achieved extensive acceptance. Fused salt descaling processes, based on caustic soda, sodium hydride or both, are effective but hazardous for continuous operations such as strip steel and wire.

Mechanical descaling methods, abrasive blasting, wire brushing, grinding and polishing, generally waste more metal and produce rougher surfaces than pickling processes. However, blasting with sand or shot is popular in the steel industry and provides surfaces to which organic coatings adhere well. Open and closed systems as well as wet and dry techniques are used for surface preparation.

Descaled surfaces are classified as white steel, commercial and brush-off finishes. White steel is cleanest and is preferred for preparing tanks, ship-bottoms and surfaces likely to be exposed to impact, immersion or chemical environments. Flame cleaning, preferably preceded by degreasing, is useful for rapid descaling of large surfaces of plate and shaped parts which are not likely to warp.

After degreasing and descaling, polishing is necessary for uniformly smooth surfaces and for corresponding uniform coatings. Mechanical polishing and buffing are old and widely used arts. Electropolishing is relatively new but increasing in importance. In contrast to mechan-

ical processes which may increase surface hardness by 30 to 40%, the electrolytic method polishes without disturbing the surface physically.

Mechanical polishing and buffing are similar operations, both employing revolving wheels. Buffing wheels are made of sewed cloth or canvas. A fine abrasive is applied intermittently from a bar or cake containing an organic binder. Polishing is a coarser operation using cloth, felt or leather wheels coated with emery, corundum or fused alumina which are held in place by glue. Solid wood or metal disks or cylinders over which an abrasive sheet is fastened are also used.

Traditionally hand operations, polishing and buffing, have been mechanized and automated in some industries to provide continuous operation. Grinding, using a solid wheel of hard and coarse abrasive and wire-brushing are used in some cases for rough polishing.

Electrolytic polishing may be regarded as the reverse of electroplating. It consists of anodic dissolution of the peaks on a metal surface. The resulting surface is exceedingly smooth and electrolytically clean. Since there is no mechanical working of the metal during electropolishing and no abrasives are used, the surface is free of scratches, strains, metal debris and embedded foreign matter. Faust' shows convincing photomicrographic evidence of this condition

Acid or alkaline electrolytes may be used. Processes have been developed for electropolishing all of the common metals. Viscous baths with relatively low conductivity are preferred. Concentrated orthophosphoric acid containing glycerine is used for stainless steels and copper, 25% potassium hydroxide for zinc and concentrated sulfuric acid for nickel.

Since surface cleanliness is vital to the quality of a protective coating, it is important to know when a surface has been properly cleaned. Unfortunately, completely foolproof cleanliness testing methods have not yet been developed. Durability of the coated surface is still the ultimate test of proper surface preparation. The most sensitive procedure for evaluating metal surface cleanliness is the atomizer test. Linford and Saubestre<sup>11</sup> developed this test in a comprehensive study

of the problem for the American Electroplaters' Society.

Material to be tested is dried in air, then sprayed by means of an ordinary bulb atomizer with water containing a small amount of blue dye. Clean areas show up as a continuous film of water while dirty areas are covered with small droplets. Other procedures in common use are the water-break test and the spray-pattern test. These and other test methods are described by Burns and Bradley' and Lux and Linford.

Once a surface has been cleaned, it is sensitive to contamination and corrosion. Subsequent coating operations must be carried out immediately and with proper precautions to prevent re-contamination. Two types of surface treatment' may be given to clean surfaces prior to coating. Surfaces to be coated with metal may be etched, grained, polished or buffed to improve adhesion or to obtain desirable appearance. Those to be painted may be treated chemically or oxidized electrolytically to produce inert corrosion-resistant surface films and improve coating adherence.

#### **Practical Metallic Coatings**

Many different techniques are practiced commercially for applying metallic coatings. Most common are hot-dipping, cementation, mechanical cladding, electroplating, metal spraying and condensation of metal vapor.

Not all metals may be applied by all methods, but usually two or more processes are practical and economically feasible for any given common metal. Since thickness, uniformity, density and adherence are all affected by the coating process, it is evident that protective quality, appearance and cost are functions of the method.

Burns and Bradley offer an excellent technical treatment of this subject. While we can not cover its many facets in detail, we shall discuss some of the factors important to understanding the role of metallic coatings in corrosion protection. In the table, we define and outline the principal coating methods.

Hot dipping is one of the most familiar techniques widely used for corrosion protection of steel by galvanizing and tinning. It uses simple, low-cost equipment and is amenable to continuous operation.

#### **Principal Application Methods for Metallic Coatings**

	Coating-Metal Requirements	Coating Characteristics	Metals Used
Het Dipping Short-time immersion into bath of molten coating metal.	Low melting point Alloying capability	Alloy layers (not pure metal) Adherent, moderately uniform Thickness difficult to control	Al, Zn, Sn, Pb, alloys
Cementation Powdered coating metal alloyed with base metal at temperature below melt- ing point.	Alloying capability	Alloy throughout Hard, brittle, porous Poor corrosion resistance	Al, Zn, Cr, W, Si, Mo
Cladding  Veneering and alloying of two or more metals under pressure; rolling of duplex ingots.	Rolling characteristics like base metal Alloying capability	Pure metal surface Impervious Controlled thickness	Cu, Ni, stainless steels, noble metals
Electroplating Electrodeposition of coating metal at cathode from solution or fused salt bath	Workable deposition potential Adhesion to base metal	Pure, uniform, impervious No alloying Unstressed Controlled thickness, hardness	Ag, Au, Cd, Co, Cr, Ni, Pb, Sn, Zn, Cu, alloys
Metal Spraying  Atomization of molten metal in hot gas stream. Wire or powder may be melted in gun by flame or arc.	Non-refractory Not easily oxidized	Porous laminated structure Harder, less dense than cast metal No alloying with surface Applicable to structures	Al, Cu, Fe, Pb, Sn, Zn, alloys
Vapor Plating Surface condensation of metal vapors by pyrolysis of metal compounds, cathode sputtering, vacuum evaporation.	Vaporizability	Costly Crystalline, fine grain Very thin Readily applied to non-metals	Mo, W, Cr, Al, Au, Ag, Ni

Properly produced dipped coatings are reasonably impervious and durable, though not as uniform and reliable as electroplated coatings.

Cementation eliminates the need for molten metal. It is a low-cost process convenient for mass production of small pieces such as screws and fittings, but generally is inferior as a means of corrosion protection.

Cladding produces a high-quality coating and is widely used with sheet and rolled shapes. This method incorporates the desirable protective qualities of corrosion resistant metals while retaining the structural properties of steel. Clad plate provides corrosion resistant vessels and other large chemical equipment at relatively low cost.

Vapor deposition of metal coatings is not of interest for corrosion protection because of its high cost and complex equipment requirements except for specialized applications to critical irregular-shaped parts.

Refinement of electroplating techniques in recent years makes this method the most important one for commercial production of protective metal coatings. Electrodeposited coatings are more uniform than hot-dipped, less porous than sprayed coatings and purer than either. Close control of the process is pos-

sible to produce platings over a wide range of thicknesses. Modern equipment makes electroplating processes virtually automatic and permits mass production at relatively low cost.

For maximum protection, successive layers of different metals such as copper, nickel and chromium are readily deposited on steel parts. About 75% of sheet steel tinning is now electrolytic. Electrodeposited zinc and cadmium are rapidly replacing the older galvanizing processes.

Successful electroplating requires proper control of three basic variables, bath composition, temperature and cathode current density. These are interrelated in complex fashion, requiring considerable experience with a particular process to obtain optimum deposit properties. It is not our purpose to discuss details of plating technology<sup>15-37</sup> or bath recipes.

Spraying is the only method of applying metal coatings that may be used in the field on existing structures. Also, it is the only feasible process' for applying heavy aluminum coatings to steel. Applications of zinc and aluminum have been made to structures of various types including ship hulls, water tanks, railroad cars and bridges, pipelines and canal gates. The coating has a characteristic stratifica-

tion or lamination of sprayed metal droplets covered with superficial oxide films. The droplets are flattened into irregular disks against the surface.

Density of sprayed metal is less than the same material in cast form. Plating hardness is increased by work-hardening and the presence of oxide. Since spray coatings are relatively porous, they can be made more effective by subsequent painting or treatment with organic sealers. Though initially more expensive than galvanizing, electroplating or painting, spraying is attractive for many applications because the thicker coatings ultimately require less maintenance.

In selecting a protective metal for a particular environment, care must be given to its corrosion resistance, cost and availability, possible methods of application and galvanic relationship to the base metal. The last is an important factor which determines suitability of different materials and method of application.

Zinc and cadmium, for example, are anodic to iron and steel, while tin and nickel are cathodic. Thus, while tin and nickel are inherently more inert than zinc or cadmium greater care must be taken in applying them to steel uniformly without pinholes or other discontinuities.

Once such a coating fails or is broken rusting of the more anodic steel is severe.

On the other hand, cadmium or zinc protect by sacrificial action. Hence, these metals continue to be effective long after bare areas develop on the surface. Consequently dipping or spraying may be permissible for zinc or cadmium, and electroplating preferred for tin or nickel. Comprehensive treatments of different metallic coatings and their important characteristics for various types of service are presented by Uhligia and by Burns and Bradley."

#### **Consider Inorganic Coatings**

Commercial inorganic coatings for protection of metals fall into two general categories, chemical or electrochemical surface conversion treatments and vitreous enamels. Those in the first group often do not constitute the final protective layer but serve as undercoating for paint or other organic materials. A typical process is bonderizing which uses a manganese dihydrogen phosphate bath to create a mixed coating of iron and manganese phosphates on steel surfaces.

Other proprietary phosphatizing compounds' are applied to zinc, aluminum and tin. Chromate conversion coatings are widely used on zinc and cadmium plated articles to retard the formation of undesirable corrosion products. These base coatings function as inhibitors as well as moisture excluders and are rarely used as paint bases.

Chemical dip methods are employed to create protective oxide films on iron, steel, stainless steel, aluminum, copper and some of their alloys. Such films are usually very thin and are frequently colored. Black oxide and bluing treatments for steel are familiar types. These films also provide abrasion as well as corrosion resistance.

Protective oxide coatings may be made electrolytically. Examples are the various anodizing treatments for aluminum which produce a relatively thick, abrasion-resistant coating which is capable of coloring with organic dyes and also provides electrical insulation.

Chromic, sulfuric or phosphoric acid baths form the oxide coating which is sealed with boiling water or steam following the anodizing operation. Sealing with hot silicate or dichromate solutions is preferred for greatest corrosion protection. Magnesium may also be anodized; although new processes for this metal are still undergoing commercial evaluation.

Though brittle and not as serviceable mechanically as other types of coatings, ceramic or vitreous coatings are preferred for many applications in the chemical, pharmaceutical and food industries. Vitreous coatings possess hardness and essentially complete inertness to many corrosive environments.

Enameled (glass-lined) vessels and other equipment are available commercially in a variety of shapes and sizes. These enamels are made from fused silicates of various compositions, containing collodial suspensions of coloring materials. Sheet stock is generally made by the wet-process in which the enamel is applied as a slurry. Castings are enameled by the dry-process in which a powder is applied. Subsequent firing conditions are dictated by enamel composition and intended service.

Recently, new ceramic coatings composed of more refractory formulations<sup>16</sup> than the common porcelains have been introduced. These new materials are capable of resisting corrosive atmospheres at temperatures up to 3,500 F. High cost and complex manufacturing procedures limit the commercial development of these newer refractories. As a byproduct of rocket and jet engine research, the chemical industry will benefit from materials of this kind.

#### Organic Coatings Are Many

Organic coatings represent a large variety of materials and are the most widely used means of protecting metals against corrosion. It is estimated that over \$2 billion are spent annually in the U. S. on organic coatings. During the past ten years, great strides have been made in the introduction of new materials and improvement of finishing processes and quality of coating materials.

More than a thousand different synthetic resins, as well as a vast variety of pigments, modifying oils and solvents, are used in coating formulations. The paint industry increasingly depends on large chemical manufacturers to provide in usable form the various ingredients for organic finishes.

Organic coatings protect metals by interposing a continuous, adherent, inert film between the metal and its environment. While electrochemical relationships are important in the protection afforded by metallic and some inorganic coatings, different factors are significant with organic coatings. The degree to which the environment can be blocked off physically from the corrodible metal is the main factor.

Another important aspect is that organic coatings markedly change the appearance of the finished metal. Hence they are applied for decoration as well as protection. Their dielectric properties also lead to their use for electrical insulation purposes. An organic coating must be strongly adherent, impervious and inert to the chemical and physical environment of exposure. The longer the coating retains these properties, the less maintenance it requires.

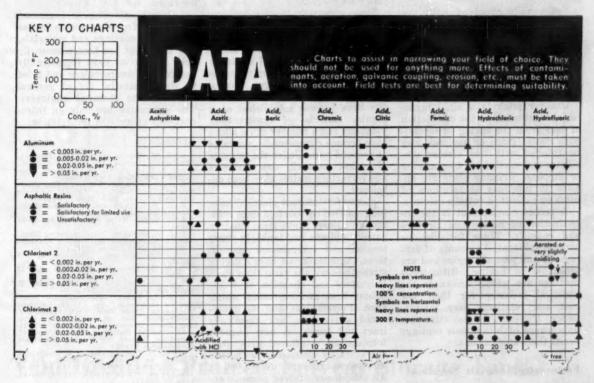
As we know them today, organic coatings belong to three classes, paints, enamels and lacquers.

Paint is a dispersion of pigments in a vehicle which consists of drying oils modified with solvent or thinner to aid application. Drying mechanism is oxidation and polymerization of the drying oil. Usually brushed on but may be sprayed.

• Enamel is a dispersion of pigments in varnish or resin vehicle which polymerizes either by oxidation at room temperature or by application of heat. Resins may be natural or synthetic, dry faster than paint vehicles into harder, tougher and smoother films. Applied by brushing or spraying.

Lacquer is a pigmented natural or synthetic resin dissolved or suspended in solvents. Drying is by solvent evaporation. Usually sprayed.

Paints are used mainly for protection and decoration of large fixed structures such as tanks, towers, piping and buildings. Paints are applied in the field, although a preliminary or primer coat may be applied at the factory for protection during storage and erection. Enamels are more decorative and mechanically resistant. Thev normally applied at the factory under controlled conditions on smaller metal equipment. Lacquers have various specialty uses, requiring careful spraying of several thin layers to assure proper solvent



volatilization and final film characteristics.

Conversion of liquid films of organic materials to dry coatings involves a variety of chemical reactions. These include auto-oxidation, condensation and addition polymerization. Explanation of these reactions is beyond the scope of our present discussion. Rather extensive literature. Has accumulated on this subject of which the references given here are only a sample.

Since many different materials are available for use as vehicles, pigments and solvents, the compounding of organic coatings for various uses involves a near infinity of combinations. For our purpose, we will mention some of the principal materials and indicate desirable properties for various applications.

As a vehicle, linseed oil continues to be the most widely used material. Tung oil and chinawood oil formed the basis for enamel formulations prior to World War II but shortages of these materials forced the development of substitutes such as modified linseed, soybean and castor oils.

Research on drying oils is con-

tinuing. Materials based on styrene, cyclodienes and higher alcohols appear quite promising. Eventually, it is likely that completely synthetic drying oils will replace present natural and modified products. A good drying oil should not only be capable of rapid polymerization at reasonable temperatures, but must then remain reasonably inert to the weathering effects of moisture, oxygen, ultraviolet rays and atmospheric contaminants.

Catalysts (driers) accelerate drying by promoting the desired polymerization reactions. Driers are commonly metallic soaps of lead, manganese, cobalt, iron, calcium or zinc. These driers comprise only a very small percentage of any paint formulation.

A striking feature of the organic coating industry has been the rapid increase in the use of synthetic resins. They now outweigh natural materials by 15 to 1 and account for over 25% of the entire production of plastics. Alkyd resins constitute over 60% of those used in protective finishes. Development of alkyd resins made possible the present line of enamels. Other

resins are phenolics, urea and melamines, styrene-diene copolymers, vinyls, coumarine-indenes and rosin and cellulose esters. Ethoxylene resins (epoxy-ethers) are an outstanding group of materials which show considerable promise for coating applications.

In addition to coloring organic finishes, pigments have several other important functions. Pigments strengthen, harden and make coatings more durable. Pigments also impart body to the coating and often serve special needs such as corrosion inhibition or light and heat reflectivity. In selecting pigments, care must be given to particle size, shape and size distribution as well as to chemical and physical properties and the cost and availability of materials. Very fine particle sizes ranging from 0.1 to 5 microns are common.

Commonly used inorganic pigments are titanium dioxide, lithopone, chromium oxides and chromates, ferrocyanides and lead oxides. Organic materials include carbon blacks, azo dyes, anthraquinone colors and phthalocyanines. Improved dye and pigment technology has made possible the

presently popular pastel paints and

Not readily classified with the previous finishes are bituminous coatings which are another type of organic coating. Asphalt is a semisolid mixture of complex heavy hydrocarbons obtained originally from natural deposits but now primarily from petroleum residue.

Coal-tar pitch is a similar material obtained from the distillation of tars from the coking of bituminous coals. Pitch or asphalts may be thinned with less viscous distillates and applied hot by spraying or dipping. Priming coats are applied to pipelines as solutions of pitch or asphalt in volatile solvents.

A recent development is the introduction of bituminous lacquers and enamels. These formulations contain substantial amounts of drying oils and phenolic resins and are amenable to baking. Bituminous coatings are widely known in the chemical industry for their low cost and relatively easy maintenance. However, the less attractive appearance of bituminous coatings limits their applications.

#### **Factors in Materials Selection**

Design engineers select the most practical material of construction for each case of corrosive service by proper balance of corrosion resistance, mechanical properties and cost. Each of these is equally important in making the final choice. Under mechanical properties, they consider structural characteristics and methods of fabrication.

In this article, we can not discuss materials selection in detail. However, we can point out some sources of information on corrosion resistant materials. Manufacturers' catalogs, particularly from organizations active in corrosion research such as the several major steel companies, aluminum and nickel producers and the principal producers and fabricators of plastics are excellent sources of corrosion data. The "Engineering Materials Handbook," devotes a chapter to a series of charts indexing the principal corrosion resistant materials. A portion of one of these charts is shown in an adjoining illustration. Such charts serve as a means of rapidly reducing the field of choice for a given corrosive environment. Many magazines publish regular articles on new developments and periodic materials reviews.

Since corrosion is such an important problem in all branches of industry, research on materials of construction is vigorous and fruitful. Today the chemical engineer deals with materials completely unknown a generation ago. During the past five years, reinforced plastics have become established as a regular material of construction. Titanium and a number of its alloys have become commercially available at reduced cost. Under the impetus of rocket research, new ceramics and refractory metals have been developed.

Sales of reinforced plastics have increased nearly fourfold since 1954. Industrial uses range from building panels to piping and tanks. In many tension and compression applications, these materials have a higher strength-to-weight ratio than steel. Polyesters and phenolics show excellent heat and corrosion resistance. Polyethylene and its fluoronated derivatives are chemically inert and tough. A new phenolic formulation, reinforced with vitreous silica, is claimed to withstand short-time exposures over 5,000 F. An asbestos-reinforced phenolic endures 500 F. for 100 hr. or more.

Most manufacturers offer a variety of materials. On the basis of material cost, reinforced plastics are still at a disadvantage. Reinforced-polyesters cost about 80¢/lb. compared to 14¢/lb. for sheet metal. However, for many applications this greater costs may be offset by lower fabrication expenses and lower installation cost.

As a final example, we shall mention titanium. With constant expansion of production facilities, titanium capacity doubled 1955-56 and again in 1956-57 with a corresponding 50% reduction in price. This metal is now available in a full line of mill products, including wire, tubing, screen, valves and forgings. It is 44% lighter than steel and available in the same strength ranges.

Titanium demand by the chemical process industry is growing rapidly and may soon exceed that of the aircraft industry. Though it possesses a number of remarkable corrosion-resistant properties, tita-nium should not be regarded as a cure-all. Its resistance is poor in hot or concentrated reducing acids, hot concentrated aluminum or zinc chlorides, dry chlorine and ionizable fluorides

This article covers in a general way the control of corrosion by use of resistant coatings and materials. Our treatment has been necessarily brief. Thus we have intentionally avoided the commonplace and tried to stress material not of general knowledge to chemical engineers. The references are only an introduction to corrosion information.

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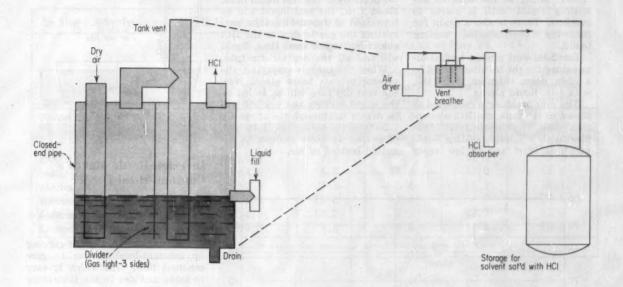
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## DESIGN NOTEBOOK EDITED BY T. R. OLIVE



## Vent Breather Protects Solvent Storage Tanks

If you're storing solvents saturated with HCl, then this moisture-excluding vent breather will simplify your problem.

**★Winner of the August Contest by** 

C. W. Hamilton

Process Development Supervisor, Wyandotte Chemicals Corp., Wyandotte, Mich.

If you have to vent storage or surge tanks containing organic liquids saturated with dry HCl gas, you will be faced with a design problem. Such liquids are encountered where HCl is evolved, as in chlorinations and Friedel-Crafts condensations. If you can exclude moisture, then you can build your tank from metallic construction materials. If you can't, then the resulting corrosion will force use of the more expensive non-metallics. The evolution of HCl is unavoidable and its presence prevents the use of conventional adsorptive dryers on the tank vents.

Sketched at the left above is a simple device for excluding water vapor and at the same time making it possible to recover the evolved HCl. This two-way hydrostatic "check valve"—which I prefer to call a vent breather—is hooked up

as shown in the sketch at the right. It can easily be fabricated in any welding shop.

The vent breather consists of two closed chambers which can either be in the same vessel, as shown, or separated into two vessels, provided that the vertical relation is maintained. The chambers are joined at the bottom by means of a slot or equalizer to permit liquid circulation.

Each chamber is fitted with a dip pipe which reaches nearly to the bottom, plus a vent coupling. Note that the dip pipe of one side is joined to the vent coupling of the

#### **NEXT ISSUE: Watch for Announcement of September Winner**

#### \* How Readers Can Win

\$50 Prize for a Good Idea—Until further notice the Editors of Chemical Engineering will award \$50 each four weeks to the author of the best short article received during that period and accepted for Plant or Design Notebook.

Each period's winner will be announced in the second following issue and published in the third or fourth following issue.

\$100 Annual Prize—At the end of each year the period winners will be rejudged and the year's best awarded an additional \$100 prize.

How to Enter Contest—Any reader (except a McGraw-Hill employee) may submit as many contest entries as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Acceptable non-winning articles will be published at space rates (\$10 min.)

Articles should interest chemical engineers in development, design or production. They may deal with useful methods, data, calculations. Address Plant & Design Notebooks, Chemical Engineering, 330 W. 42nd St., New York 36, N. Y.

other for connection to the tank vent. One of the chambers has a fill connection about one-third of the way up the side. This permits "blind" filling of the tank by admitting liquid until it starts to overflow. There is also a drain for removing contaminated sealing liquid.

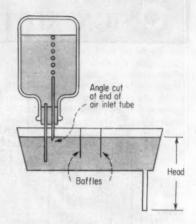
For 2-in. vent piping, typical dimensions for the breather would be a 12-in. diam. chamber 10 in. tall,

with 1-in, liquid piping.

The vent breather is connected as shown to the tank, the HCl absorption tower, and the air dryer. It is filled with a suitable sealing liquid which is inert and of low vapor pressure—kerosene or fresh process liquid, for example.

When the storage tank is filling or filled, HCl will be evolved. At the pressure of the seal liquid head, about 2 in., the seal liquid will be forced out of the vent dip tube, permitting the gas to flow to the HCl absorber. At the same time, liquid will seal off the dry air dip tube.

When the tank is emptying, the reverse process takes place. Now the vent dip tube will be sealed by the slight suction and dry air will be drawn in through the other dip tube from the air dryer. If desired, of course, an inert gas can be admitted instead of air.



#### Inverted Bottle Makes a Constant-Head Feeder

H. Leslie Bullock

Engineering Consultant, New York 6, N. Y.

There are many ways of rigging up constant-level devices to give constant flow. One which is easy to make and use in the laboratory is shown above. Actually, there is a still simpler method which involves some turbulence and surging of the liquid and so does not give quite as good level control. This consists simply in inverting a filled bottle over the liquid-filled tank so that the bottle mouth just touches the liquid surface in the tank. When the tank level falls a large air bubble enters the bottle, allowing enough liquid to flow to the tank to re-seal the bottle.

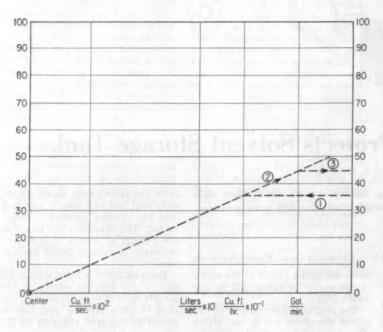
The more refined method shown in the sketch makes use of two tubes of unequal length. It gives a smoother flow and a more accurate level.

Note also that constrictive action of the tubes makes it easier to invert the bottle into the tank with a

minimum of spillage.

The longer tube, which is anglecut at the bottom, admits air to the bottle in smaller bubbles and a more continuous stream than the submerged-mouth bottle. Thus it allows a more uniform flow from the shorter tube. Tubes of the right size will hold a very close level. Adding baffles in the tank helps to iron out surges, while increasing the tank area helps to maintain a more uniform depth.

The same idea has been used commercially to supply liquid for saturating tanks and roll coaters and roll printers.



## **Chart Converts Flow Units**

Jerome A. Seiner

Development Engineer, Pittsburgh Plate Glass Co., Springdale, Pa.

The chart above (like the author's similar chart for pressure units in *Chem. Eng.*, p. 150, May 5, 1958) is a handy way of converting quickly from one system of flow units to another. The units included are: gal./min.; liters/sec.; cu. ft./hr.; and cu. ft./sec.

Enter the vertical scale horizontally at the numerical value of the quantity to be converted and move to the vertical line labeled with the original units. From the intersection draw a line downward toward the left through the "center." The intersection of this line with any of the vertical lines marks the converted values for those units. For example, 350 cfh. (Line 1) equals 43.7 gpm. (Line 3), as found by following Line 2 to intersect the gal./min. line.

## YOU & YOUR JOB EDITED BY R. F. FREMED

	14 10 100	Percentage of Graduates as of May 20, 1958						
Engineering Curriculum	With	Entering Graduate Studies	Entering Military Service	Considering Jobs	Without Any Job Offer Or Otherwise Uncommitted			
Aeronautical	60.3	8.1	13.6	11.9	6.1			
Chemical	46.4	15.8	9.6	11.7	16.5			
Civil	63.0	8.6	9.6	12.8	6.0			
Electrical	63.8	9.6	6.8	12.3	7.5			
Industrial	54.8	6.8	11.6	11.0	15.8			
Mechanical	62.8	7.3	8.6	11.2	10.1			
Mineral	46.3	12.6	9.6	7.9	23.6			
Others	54.3	13.2	8.3	12.2	12.0			
Over-all average	59.0	9.8	8.8	11.6	10.8			

## Final Score: No One Without a Job Offer

All's well that ends well. In spite of some springtime sadness about the job outlook for engineering graduates, they all found something by graduation day.

After several years of feverish recruiting activity and scrambling by employers to sign up the limited supply of engineering graduates, fears developed on campus early this year that the job feast might turn into a famine.

The fears were groundless, according to the latest survey released by Engineers Joint Council.

EJC's survey concludes that in view of the adverse general business climate and other unfavorable factors prevailing early this year, placement opportunities for engineers reflected a remarkable degree of stability. Results shown in the table above used the date of May 20th for standardization. Reply blanks were accepted through June 10th. The survey, then, pictures the job outlook for new engineering graduates about one month before graduation day at most schools.

Canvassing was done by mail addressed to the deans of engineering of 159 colleges with curricula accredited by Engineers' Council for Professional Development, and 53 others that award engineering bachelor's degrees. The deans were requested to provide, through their placement officers, placement information in summary form on simple questionnaires provided for this purpose. By the cut-off date replies had been received from 115 accredited colleges and from 31 nonaccredited institutions.

#### Late Replies More Optimistic

EJC made no followup to determine what change took place following graduation. However, a few late returns, received after June 20th, reflected these results:

Engineering graduates with jobs, 83.5%; planning to enter graduate schools, 8.0%; entering military service, 7.5%; considering job offers, 1.0%; without job offers, none.

Final conclusion by EJC: "If these results are even remotely representative, it is apparent that

within the last month of the academic year engineering graduates were all able to complete their plans for post-graduate activities.'

For purposes of comparison the colleges were also asked to provide equivalent information for graduates in other fields. Although these data were limited-because placement officers, in general, did not have similar records for other groups—the information supplied shows that physical science graduates are roughly equivalent to engineers when the large proportion of those planning to take graduate studies is considered.

Graduates identified in business administration and general liberal arts did not fare as well, with 25% and 30% respectively uncommitted by May 20th.

#### Why Are Chemicals So Low?

The survey results as presented in the table spot the uniqueness of chemical engineering graduates as compared with other branches of the profession. Except for mineral engineers (and we know that mining is a recession-slumped industry today), the chemicals show the lowest employment percentage.

Percentagewise, more chemical engineers plan to go on to graduate studies. However, this decision may have been influenced by a lack of enticing job opportunities.

Most surprising is the 16.5 percentage for chemical engineering graduates without a job offer or otherwise uncommitted. What happened to the long-range recruiting programs of chemical, petrochemical and petroleum employers?

#### THIS KNOWLEDGE

#### . . . Belongs to the Employer

Final settlement has been made without trial in the lawsuit brought by Young Radiator Co., Racine, Wis., against the Perfex Corp. of Milwaukee and Hiram J. Kinkade, also of Milwaukee. You can now add this to your file on "Does Your Employer Own Your Knowledge?" (see Chem. Eng., July 28, 1958, pp. 127-130).

Action was begun by Young in the Circuit Court for Milwaukee County in April 1957. In its complaint Young charged that Kinkade had been employed by them for a number of years as sales manager in charge of air-cooled heat exchangers. During his employment, Young states, Kinkade was given access to a large amount of confidential data, engineering matter and information constituting trade secrets belonging to the Young Radiator Co.

Kinkade left Young's employ early in 1956 and Perfex hired him about six weeks later. Shortly thereafter Perfex announced that it was bringing out a line of aircooled heat exchangers to be handled through a newly formed division of which Kinkade had been made manager.

According to F. M. Young, president of Young Radiator, the Perfex announcement indicated that its new line would be directly competitive with the equipment that had

been sold under Kinkade's jurisdiction when he was employed by Young.

After suit was begun. Kinkade was examined by attorneys of plaintiff and Young Radiator asserts that they learned this: When Kinkade left Young's employ he took with him several hundred sheets of Young design and laboratory data, price sheets and prints of confidential engineering drawings. Mr. Young added, "Kinkade made available to Perfex a data book that was our 'bible' for the jacket watercooler business. He also had our price lists, so that in submitting bids on air-cooled heat exchangers for industrial and oil-field applications Perfex was in the same position as a poker player who has a clear view of the other fellow's hand."

As part of the settlement Perfex has now submitted to a consent judgment which requires it to return to Young Radiator all copies in its possession of Young's data sheets, and other confidential engineering information. The injunction order also required that Kinkade do the same. Perfex also paid damages to Young, the amount of which Mr. Young declined to reveal.

#### GRADUATE STUDY

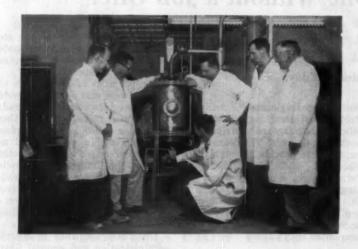
#### . . . Gets Tax Rebate

As the result of a test case instituted by teachers, the Treasury Dept. has ruled recently that employees may deduct from their income tax courses taken voluntarily to improve skill in their work.

Deductions may be made even though the extra courses help a person qualify for promotion or higher salary. Previously the government held that the cost of a course that helped a person achieve a promotion was not deductible.

The ruling is retroactive to 1954 and includes such expenses as cost of lodging, travel and meals for courses taken away from home; the cost of courses taken to keep one's skills on a par with those of colleagues and competitors, and the cost of courses required by one's employer as a condition for keeping a job, "salary or status."

Treasury explained that the ruling removes the distinction previously drawn between self-employed persons and employees such as teachers and engineers.



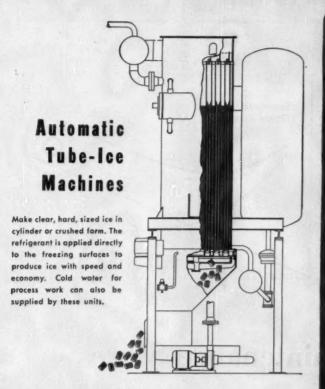
#### To Save 75%, Design and Install It Yourself

Chemical engineering students at South Dakota School of Mines & Technology have reached the halfway mark in the design, construction and installation of equipment in their new laboratories.

Project is being directed by R. F. Heckman, chairman of the chemical engineering dept. at S. D. Tech. Various sections of the laboratory have been built in miniature and now these models are being used to plan, construct and install the working equipment, such as the copper batch still shown being inspected.

Construction costs have been reduced nearly 75% because of student participation in the project.

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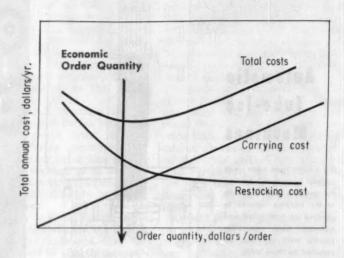
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## OPERATION & MAINTENANCE EDITED BY M. D. ROBBINS

You must balance stores investment, effect on production and control costs to obtain the lowest over-all costs for your maintenance stores.



## **Optimize Your Maintenance Stores**

R. E. BLEY, Maintenance Consultant, Engineering Department, E. I. duPont de Nemours & Co., Wilmington, Del.

In the chemical industry, maintenance material represents about 40% of the total maintenance bill. To stock these materials you need a fair amount of working capital on hand.

Although these costs are sizable, they're really small when compared to a production loss caused by lack of replacement parts. Simply: your problem is to have the required materials on hand with the lowest material inventory.

#### What Are Stock Requirements

From a cost standpoint, stock requirements are one of your most important problems with maintenance stores.

To start, you must know the type and category of items:

• Standard supplies or stores items such as nuts, bolts and pipe fittings. These have a predetermined rate of use and you know your requirements.

• Insurance items or protection

spare parts. You don't know the turnover on these parts but they must be available to avoid costly shutdowns.

Complete assemblies or machines—spare equipment. These are usually capitalized.

It's sometimes difficult to place every item into a category but it's an absolute necessity for a good analysis.

You must remember, when figuring spare parts requirements: the investment in stores, spare parts and capital spares must earn a return the same as any other investment.

You can improve your return on maintenance stores by one of three methods:

• Reduce the investment in parts if the inventory is higher than necessary.

 Increase the investment in parts if this reduces process-equipment downtime.

 Maintain the same total investment in stores materials but order the proper quantity at the optimum time.

#### Determine Your Parts Needs

Let's consider stores items that are low unit-value with a high turnover. Soundest approach to controlling this type of stores material is a maximum-minimum system. Basically, it consists of:

• Minimum or protective stock level—This is a function of the stock-out cost, demand for the item and availability of replacement parts.

 Order point—Set by the delivery period of replacement stock.

• Order quantity — Together with the order point, this establishes the maximum stock level.

Although most plants use a maximum-minimum system, the various quantities are generally set by rule-of-thumb or opinions rather than sound engineering and economic principles.

You can establish realistic order quantities of stores items with the economic order principle. This is a simple method of balancing carrying costs and restocking costs to obtain minimum total cost. When you consider both restocking and carry-

This article is based on a paper delivered at the Maintenance and Plant Engineering Conference of the ASME in Pittsburgh, Pa., April 14-15, 1968.

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High initial cost? Sure! But titanium means less equipment to replace, less downtime for repairs . . . can actually save you money on processing equipment and parts!

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#### **Needs Set Your Order Quantity**

Annual Needs, \$	EOQ,*	Orders/ Year	Order Period
100	55	1.8	6 Mo.
500	123	4.1	3 Mo.
1,000	174	5.7	2 Mo.
5,000	388	12.9	4 Wk.
10,000	548	18.2	3 Wk.
50,000	1,228	40.8	9 Days

\*Basis: Restocking cost = \$3.00 Carrying cost = 20%

ing costs, the amount giving minimum total cost is the economicorder quantity.

For figuring this economic-order quantity, the formula is a squareroot function of the annual consumption of an item, expressed in dollars:

$$EOQ = \sqrt{\frac{2AK}{I}}$$

where: EOQ = economic order quantity in dollars, A = annual requirements in dollars, K = restocking cost per order in dollars, and I = carrying cost as a decimal,

Unit carrying and restocking costs are constants for any particular plant. Determine these constants once and they don't need modification except for major changes in policy or routine.

Unit restocking cost represents all reordering costs that vary with the number of orders placed. This includes placing orders, writing orders, filing, expediting, communicating and invoicing. It doesn't include nonvariable phases such as talking to salesmen, making price agreements and writing management reports.

Carrying costs include obsolescence, interest on the required working capital, storage costs and similar factors. Carrying costs often amount to 15-25% of the investment required.

Once you determine the unit restocking and carrying costs, application of the economic-order principle is simple. Develop a table, such as shown above, to suit your particular requirements.

In the example shown, assume: \$3.00 unit restocking cost and 20% carrying cost. With the economic order principle, an annual consumption of \$100 worth of a specific type and size of gasket indicates an order frequency of six months or twice a year. Increasing the annual consumption to \$10,000 makes the

order frequency once every three weeks.

In this system, control is concentrated on items with high-dollar expenditures but it still allows evaluation of all items. Through this approach, the cost of frequent ordering of many low-cost items, with excessive clerical expense, is optimized without significantly increasing stores investment.

In many cases, the cost of restocking low-cost items is more than their purchase price. Conversely, more frequent ordering of the high-dollar-volume items substantially reduces investment without appreciably affecting restocking costs.

Plant experience with this technique is very favorable. One case reports a stores investment reduction of about 50%. In another case, clerical work for purchasing, accounting and stores operations was improved by a 50% reduction in the number of orders placed.

#### Consider Price Discounts

There are several other factors to consider in establishing the economic order quantity. One of these is a price discount for volume purchase. Discounts of this type have a controlling influence on the quantity of an item purchased.

Quantity discounts can increase the economic-order quantity as shown in the table above. An item with \$1,000 annual consumption would normally be ordered about six times per year. Quantity discount of 1% permits a three-time annual order frequency; while a 7½% discount reduces this to once a year.

In the example, if a 5% discount applies to an order of \$500 or more, you should order the \$500 quantity. If the 5% discount applied to a minimum of \$1,000, you should order only \$174 worth. In other words, the additional carrying charges for the \$1,000 order, more

than offset the volume discount available.

These formulas are valuable in establishing stores quantities. However, no formula or table replaces good common sense and judgment. They merely help you arrive at the best answer. For example: space limitations, limited shelf life or possible obsolescence may be determining factors dictating smaller quantities than otherwise indicated.

#### When to Order

Once you determine the order quantity, you must fix when to order this quantity. Consider both a minimum stock level and an order point. Used together, the combination provides insurance against stock-outs of stores items.

Using this system, an order is placed when the stock level reaches the order point that provides for delivery time. Minimum or safety points serve as a warning if there's an extension of the delivery time or above-average use of material. Adding the minimum stock plus the average demand during the delivery period gives you the order point.

To determine minimum stock levels with a rigorous statistical approach, you need a detailed record of disbursements and a knowledge of the cost resulting from a stock-out. Such a statistical analysis generally isn't justified for the thousands of stores items. Fortunately, the cost of a stock-out of a stores item (not a spare part) isn't very significant since it has little effect on production. Base minimum stock levels on experience alone and you'll still be safe.

There's a relationship between order quantity, minimum stock level and stock-outs. An increased order frequency reduces stock-outs since it reduces the number of orders placed. It's necessary to reduce the stock level below the order point to have a stock-out and the fewer

#### How to Figure Maximum Order M With a Quantity Discount

	M = (200Q)	$(K + Q^2d)$	+ √(200QK -	$(-Q^2d)^2-4$	$0,000Q^2K^2$	
	24 -		200K		-9/	
Annual	Normal -		Max. Order fo	or Quantity	Discounts -	100
Needs, \$	EOQ, \$	1%	2.5%	5%	7.5%	10%
1,000	174	370	550	820	1,080	1,340

Basis: Restocking cost = \$3.00; Carrying cost = 20%Nomenclature: d = Quantity discount, %; Q = Economic order quantity (EOQ), \$; M = Maximum order for quantity discount d, \$; K = Restocking cost/order, \$.



# FLAMMABLES ENGINEERING BY PROTECTOSEAL

FLAMMABLES CONTROL METHODS AND PRACTICES IN PRODUCTION, PROCESSING AND IN MAINTENANCE

PUBLISHED BY THE PROTECTOSEAL COMPANY, CHICAGO, ILLINOIS

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#### WHAT'S NEW . . .

#### PROTECTOSEAL DRUM VENT FOR END BUNG INSTALLATION

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# Flammables Storage Cabinet earns 3 more approvals

The Protectoseal Flammable Liquids Safety Storage Cabinet, designed to meet the specifications of the N.F.P.A. for on-the-job storing of up to 45-gallons\* of flammables, has recently been approved by 3 more official agencies: National Fire Protection Assn.; Board of Standards and Appeals for City of New York; Pennsylvania State Police, Bureau

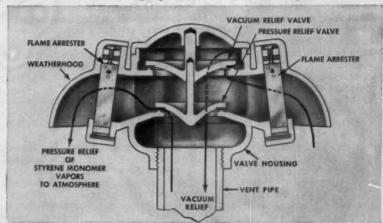
of Fire Protection. Cabinets will now carry all 3 approval labels on the front doors.

\*When stored in approved safety containers of not more than 5-gallons capacity each.



For Further Information Circle Item 11 on Coupon

# Styrene monomer vapors controlled to reduce vent clog-up...prevent tank rupture



Chemical manufacturer stores styrene monomer in 30,000 gallon horizontal tanks at atmospheric pressures and temperatures. Plagued by polymerizing which clogs flame arrester vents . . . flash point of 90°F requires protection against ignition of vapors from outside sources. Tried various means to keep arresters open without success . . . installed Protectoseal conservation type vent with flame arrester located outside the valve housing . . . arrester now subject to vapors only when valves open. Result: checked weekly during 11-month period . . . including hot summer months . . . report no plugging of valves or arresters . . . tank protected against fire and explosion arrester location outside valve housing provides for quick, visual inspection.

For Further Information Circle Item 17 on Coupen

### Safety space-savings in chemicals handling



Oval shape, 1-gallon laboratory safety container requires far less shelf space for chemicals storage . . . four cans easily placed in same area required by two or three ordinary cans. Protects volatile chemicals from fire and explosion . . . provides easy method for storage and visual labeling.

For Further Information Circle Item 18 on Coupon

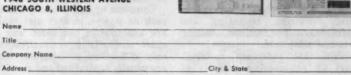
FLAMMABLES	ENGINEERING	DATA FOR	THE CHEMICAL	PROCESS	INDUSTRIE!

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- Manual of Laboratory Safety Equipment

  More Information on Items Circled Below:
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times this occurs, the fewer stockouts expected.

In contrast to low-cost, high-turnover stores items, spare parts have higher unit costs and are slower moving. Many spare parts are considered protection or insurance items. If these aren't available, production can be critically disabled. Restocking cost is small when compared to stock-outs and carrying costs. For this reason, you only have to mathematically balance the cost of stock-outs against the cost of carrying the item.

Stock-out cost is a function of the unit cost of downtime, its frequency (determined by equipment life) and duration of downtime (controlled by the parts-delivery time). Carrying cost is a function of purchase price and carrying charge, expressed as percent of investment.

Mathematically, this is simple. Really, the problem is having records for a long enough period of time to give required data for downtime. This information isn't frequently available—particularly for new plants. However, there's sufficient information based on experience with similar equipment and operations—information good enough for you to predict your requirements.

#### Record Keeping: All Important

In many plants, both old and new, one of the more difficult and time-consuming jobs, in determining your parts requirements, is obtaining important information such as specifications, price and delivery.

In some cases, this is complicated even further because the original parts manufacturer's numbers are replaced by numbers used by the equipment manufacturer. Typical case of this is with ball bearings, where the original manufacturer's bearing number is often deleted and replaced by an equipment manufacturer's number.

Because of the great effort to obtain reference data, it's good practice to request it in your original purchase order. In addition, assemble the information in an equipment reference file before analyzing spare parts requirements.

This file should contain all correspondence, purchase orders, parts lists, drawings, operating and maintenance instructions, catalog data and price lists.

With this reference material, start an engineering analysis of

your spare-parts requirements. Use an equipment analysis sheet for this purpose. A separate sheet is used for each piece of equipment or groups of similar equipment.

Tabulate all parts that are maintenance problems. Base this on experience or knowledge of the components design life. With key equipment, base it on the risk involved.

Consider what you must do when a failure occurs. Ask yourself:

• Can I recondition the part in the plant or local outside shops? • Can I fabricate a new part in

the plant or local shops?

Are parts stocked by local distributors?
Can I use substitute parts or

materials?

• What's the time and cost of reconditioning against the time and

cost of direct replacement?

Where you decide not to stock a part for these or similar reasons, note why on the analysis sheet.

Weigh information on quantity price and delivery time along with considerations such as probability of failure and effect on production. Make a mathematical analysis when a particularly high-priced item is involved.

A parts recapitulation sheet is also of value. Here, the purpose is to consider, on a plant-wide basis, widely used items such as bearings, seals, valves and V-belts.

Final selection of quantities stocked is based on plant-wide use rather than accumulated total for individual units.

With a thorough analysis, you can have an adequate inventory with a lower investment in parts. This is partially due to elimination of duplicated items, but mainly because you consider all the significant engineering and economic aspects. In a chemical plant, a detailed analysis of stores and spare parts indicates an expenditure generally less than 1% of plant investment.

An example of such an analysis is a new plant built on an existing plant site. Experience at the plant site indicated a \$26,500 investment in parts for the new plant. Detailed analysis resulted in stocking only \$10,000 worth of parts with ample protection.

Complete or self-contained units, such as pumps, motors and tanks, are analyzed in the same way as spare parts. In this situation, the only difference is complete units are usually capitalized and classified

as extra machinery or capital spares.

Because of the high cost of some capital spares, a detailed economic analysis is usually necessary. Consider whether to install the spare unit or keep it in the storeroom until needed. Time required to install it, possibility of using it at more than one location and cost of downtime are major factors in this decision.

### Make Parts Available

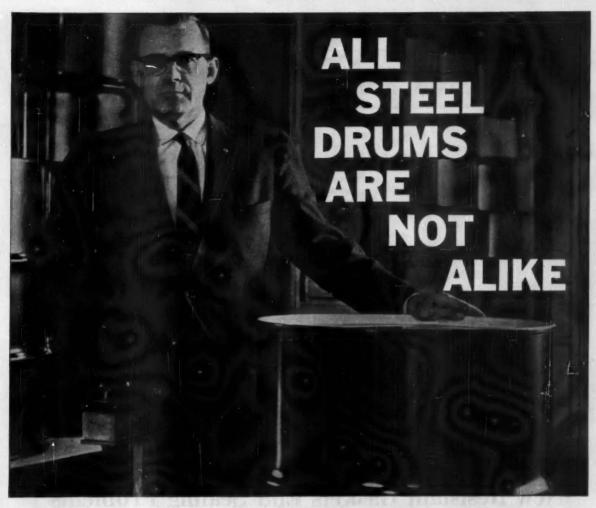
Once you've set your parts requirements, and in some cases before that, look into storage location. Maintenance stores location in a large plant is very important.

If you use only a central stores, with considerable travel time or even with frequent truck delivery, you may be in trouble. In this situation, try supplying low-cost high-turnover items to the area maintenance shops on a weekly basis. Availability in the area saves time and reduces clerical work. Material can be avaliable on a self-service basis in the area shop without requiring a stores ticket.

When you establish area stores to supplement central stores, limit quantities to a 7 to 10-day supply. Maintain control by a weekly inventory. Subtracting the inventory from the permissible stock gives the order quantity.



R. E. BLEY has been in maintenance work for the last seven years and is currently Consultant Supervisor of Engineering Techniques. Background experience runs from engineering and economic evaluations of chemical processes to trouble-shooting and start-up procedures. He holds a B.S. in Mechanical Engineering from Worcester Polytech and is a member of the A.I.Ch.E.



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PRACTICE ...

# CORROSION FORUM EDITED BY R. B. NORDEN

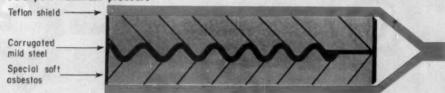
For 125 psi. maximum pressure:

Teflon shield

Hard compressed sheet asbestos

Special soft asbestos

For 300 psi. maximum pressure:



Novel shielded gaskets, developed for glassedsteel equipment, stand up to a wide variety of difficult corrosives; give long, leak-proof service.

# **New Resistant Gaskets End Sealing Problems**

B. G. Staples, Research Chemist, The Pfaudler Co., Rochester, N. Y.

Glassed-steel equipment calls for very effective gaskets. Such equipment usually handles corrosive materials, and, of course, welded or threaded connections are not practical with glass.

We have developed, after intensive research, some novel gaskets which combine the chemical resistance of glass with the physical properties of rubber. Such gaskets appear well suited for corrosive service.

Also, additional effort has gone into determining the proper method of installing gaskets over openings in glassedsteel vessels. A correct installation will give long, trouble-free service.

Five Gasket Musts - Generally, gaskets for glassed-steel equipment must: (1) have chemical inertness, to allow their use over the same range of service as glassed steel, (2) withstand elevated temperatures and pressures, (3) have physical properties that insure tight joints without high bolt which could glassed-steel flanges, (4) be airtight, leak-proof, nonporous, and free of ridges and bulky joints, (5) be capable of being shimmed to compensate for uneven or distorted surfaces.

Because selection of a gasket must begin with an evaluation of the medium to be sealed, the problem of gasketing glassed-

steel equipment was originally approached as being purely chemical in nature. It became apparent, however, that no single gasket design would successfully withstand all of the various materials being processed in glassed-steel equipment. Complex chemical processes at high temperature and pressure imposed extreme physical and chemical stresses on gasketing materials then in use. The Answer: Teflon-Experimentation with Teflon (polytetrafluoroethylene) showed its chemical resistance to be excellent. However, it could not be used unaided as a gasket because of extreme hardness in the cold state and a tendency to flow under heat and pressure.

Teflon tape, wrapped around various fillers, proved somewhat satisfactory. However,

B. G. STAPLES, very active in the area of operation and maintenance of glassed-steel equipment, is the author of the Pfaudler maintenance manual. Mr. Staples holds a MS degree in biochemistry from the Univ. of Maine.



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HAYNES alloy No. 25 was the answer in a recent test—reducing corrosion caused by hot mixtures of nitric and hydrochloric acids. It proved 12 times better than its closest rival among 11 competitive alloys.

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#### Correct Gasket Installation Pays Off in Long Life

While glassed-steel flange faces are ground and lapped to give true alignment, the nature of the firing process sometimes results in slight warpage which necessitates use of shims for a perfect seal.

Large (over 24-in.) diameters need shimming if flanges are out of plane more than  $\frac{1}{2}$  in. The operation will require 2 to 3 hours and will pay for itself many times over in longer gasket service:

1. Raise head of unit and place shim gasket (compressed impregnated sheet) on flange to protect

glass. Replace head.

2. Select a starting point on the outer circumference of the steel flange and mark permanently with prick punch. Using this mark as a starting point, make a chalk mark every 6 in. around the flange circumference. At the same time duplicate these flange markings on a piece of paper using 0 in. as the starting point and adding 6 in. for each segment so that the paper will read 0 in., 6 in., 12 in., 18 in., etc. There will be as many numbers as there are chalk marks on the circumference of the flange.

3. Using feeler gages, start at 0 in. and determine the thickness of shim necessary to produce a tight joint. Mark the amount on the paper opposite 0 in. Proceed to the next mark, gage the amount and record it opposite 6 in. on the paper. Continue the procedure around.

4. Remove shim gasket from under head and mark it off in 6 in. segments to correspond to marks on kettle. Using feeler gage dimensions, indicate desired thickness on shim gasket at each 6 in. designation. Gasket can now be sanded or ground to proper dimension using a small belt sander or grinding wheel. Although the shim need not be held to within a few thousandths, accuracy to plus or minus 0.010 in. is recommended (use micrometer).

5. Remove Teflon shield from the standard gasket. Cement shim to the single other piece of the compressed sheet which forms the center core of the standard gasket. Cement soft asbestos outer gaskets to each side of shim-center combination. You will now have a center core consisting of the hard inner gasket and shim sandwiched between two layers of soft gasket material. After cement hardens replace Teflon shield, but be sure there is no creasing or cracking.

6. Install gasket on kettle, making certain that shim is in correct position relative to 6-in. chalk marks on kettle.

7. Tighten the nuts evenly.

some seepage resulted when under internal pressure because of the numerous overlapped joints made by wrapping. High vacuum operation was unsatisfactory for the same reason.

The seepage problem was finally solved with development of the French-type shield. A thin Teflon shield or envelope is used as a chemically resistant covering for a hard central compressed core. This gives an absolutely tight seal.

► Important Designs—Such gaskets consist of a machined Teflon shield and a unique Pfaudler-developed three-piece filler or insert which varies in composition according to process temperatures and pressures:

• For temperatures to 500 F. and internal pressures to 125 psi, center core is composed of a Buna-S-impregnated compressed-sheet asbestos to provide strength. A thin layer of softer, impregnated asbestos is cemented to each side of the hard core to give resilience and compressability (see drawing).

• For high pressures—to 300 psi.—center core is composed of thin corrugated mild steel. Double thickness outer inserts are used. The combination gives necessary extra strength and also provides spring action that keeps the gasket tight, reducing the necessity for shimming (see drawing).

▶ Other Than Teflon—For specific operating conditions, where product purity is not essential or where contamination of product is not a major consideration, there are some gasket materials available, other than Teflon.

One gasket found satisfactory for many chemical conditions consists of compressed blue asbestos impregnated with Buna-S rubber. The Buna-S binder is a low-sulphur synthetic rubber that possesses desirable resilience characteristics when heated.

Blue - asbestos - impregnated gaskets are satisfactory for a fairly wide range of acids and solvents at temperatures to 500 F.; however, they are not satisfactory for powerful oxidizing agents such as boiling nitric acids in concentration over 25%, or boiling concen-

trated sulphuric acid, fuming sulphuric acid, chlorosulphonic acid and chromic acid. Neither are they recommended for brominations or for hydrogen peroxide. Compressed sheets show some seepage at elevated pressures, but this condition can be virtually eliminated by tightening when the vessel is initially heated.

▶ How About Rubber? — For physical reasons, rubber comes nearest to being the ideal gasketing material for glassed-steel equipment. At ordinary temperatures its physical properties are such that a tight joint can be maintained with a minimum of bolt tension. It is chemically inert to mild acids, and, in proper composition, can be used with solvents.

Rubber is not satisfactory at high temperatures however, and 225 F. is generally accepted as its maximum temperature. A variety of commercial rubber gaskets are available in different durometers and compositions which make them effective gaskets for many processes.

Metal Shields—Metal-shielded gaskets using a shield of lead, aluminum, tin or other suitable metal over an insert are also available for glassed-steel equipment. Inserts used with these metals must be compressable. They may be made of reinforced metal or white woven asbestos materials.

Woven gaskets, though not in general use on glassed-steel equipment because of their porosity, have been successful for certain low pressure applications. Some users of woven gaskets impregnate materials with special resins having the resistive properties desired for their particular process.

Compressed sheets made of asbestos and impregnated with any one of a variety of bonding agents have also found considerable use because of the ease of assembly and the ease with which they can be shimmed to compensate for uneven surfaces. Blue asbestos is considered to be more resistant to most chemicals than white asbestos. White asbestos has a longer fiber structure and better physical properties than the blue.

Proper selection and installa-



They're called SERVICE ENGINEERS at Durco. When you have a tough pumping problem that is really giving you trouble, a Durco SERVICE ENGINEER is near-by.

Make your own job easier. Get the right pump in the right alloy to do the job as it should be done. Durco service engineers can help you put in the pump that will give you continuous service, with minimum maintenance, at lowest operating costs.

Durcopumps are available with heads to 345' and capacities from ½ to 3000 gpm in fourteen standard corrosion resisting alloys.

Durco service engineers are available almost everywhere.



# THE DURIRON COMPANY, INC.

DAYTON, OHIO

Branch Offices: Baltimore, Boston, Buffalo, Chicago, Cleveland, Dayton, Detroit, Houston, Knoxville, Los Angeles, New York, Pensacola, Philadelphia, and Pittsburgh.

tion of gaskets for glassed-steel equipment and accessories can be instrumental in maintaining product purity, reducing maintenance and downtime, and generally producing a very favorable effect on operational costs.

#### Powdered Metallurgy Shows Off

Abundant evidence of the rapid growth of the powder metallurgy industry will be seen at the Powder Metallurgy Products Exhibit at the forthcoming Metal Exposition, to be held Oct. 27-31 at the Cleveland Auditorium.

A display of new powder metallurgy components from actual consumer and industrial products will constitute the central focus of the exhibit sponsored by the Metal Powder Industries Federation.

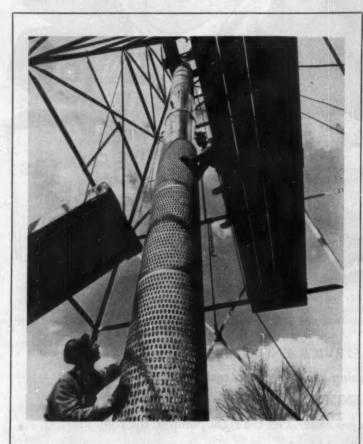
Powder metallurgy gears of almost every conceivable type and size will be one of the features of the case history display. These include spur, bevel, face, cluster, partial, skip tooth, helical and many other types-furnished with single and multiple openings of various types and shapes, including tapers, counterbores, keys, keyways, splines, squares and eccentrics.

One million powder-metallurgy gears are produced everyday in the United States-representing the largest volume of any single structural part made by powder metallurgy.

Engineers and metallurgists should be equally interested in the display of powder metal-lurgy cams. Here again, an extremely wide variety of cam types will be shown, including face, radial, box, barrel, internal, multiple plane, and eccentric cams, as well as combination cams and gears.

In addition to industrial components, the display will include other types of applications not generally known as outlets for metal powders. Various producing companies will exhibit powders used in pharmaceutical preparations, friction materials, coatings for welding electrodes. cutting and scarfing powders and rocket fuels.

Participating sponsors in the Powder Metallurgy Products Exhibit include the following: American Metal Climax, Inc.; Burgess-Norton Manufacturing Co.; The Glidden Co.; Hoeganaes Sponge Iron Corp.; the International Nickel Co.; Johnson Bronze Co.; The New Jersey Zinc Co.; Plastic Metals Div. National-U.S. Radiator Corp.; The Presmet Corp.; Pyron Corp.; Reese Metal Products Corp.; Republic Steel Corp.; Steel Vanadium-Alloys Whitaker Metals Corp.; Metal Powders, Ltd.



### Stainless Steel Screens Keep Well From Running Dry

The strange looking object in the picture above isn't a missile about to be launched at Cape Canaveral. It's a stainless steel

water well screen.

Ohio Drilling Co., Massillon, Ohio, is pioneering use of stainless steel in such applications, where the screens act as sidewalls for the water reservoir in large - capacity wells. Clean gravel is packed around the screen after it's lowered into the well; water flows from the surrounding soil, through the fill and through the screen slots.

Usual carbon - steel screens don't last more than five or six years in acidic or hard water. The stainless screens have a much longer life; and higher strengths to withstand the gravel weight.

Ohio Drilling buys Type 304 stainless from Republic Steel, in †-in. plates, press-punches †-in. wide, 11-in. long slots over the entire plate area, then welds the plates into cylinders 14-in. or more in diameter. As many as 15 five-ft. lengths may be used in one well.





# Drinking heavily for 30 years and still healthy

This U.S. Rubber Expansion Joint has been drinking brackish sea water (at temperatures from 50 to 100 degrees F.) for three decades. It and another identical 36" U.S. Rubber Expansion Joint are at work on the intake lines of #5 condenser at the Reeves Avenue Power Station of the Virginia Electric & Power Company in Norfolk, Virginia, where they compensate for the vibration, expansion and contraction caused by pumping the sea water. These are two of the first rubber expansion joints ever installed anywhere.

U. S. Rubber Expansion Joints are the economical, flexible connections that are used in all kinds of pipe lines to take care of misalignment, vibration, expansion and contraction, and noise transmission. They have no moving parts to wear or bind. They can be installed on both new and old piping and equipment.

When you think of rubber, think of your "U. S." Distributor. He's your best on-the-spot source of technical aid, quick delivery and quality industrial rubber products.



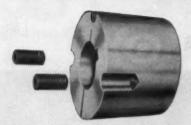
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Change from shaft to shaft	-	-0	-	-
Change from size to size	-6	-	-0	-6
Change from sheaves to sprockets to couplings to conveyor pulleys	-	-		

# • Save Time!

There's nothing like Taper-Lock for mounting wheels on shafts! First, you get off-the-shelf convenience. No reboring, no machining, no waiting!

# Save Work!

You get the holding power of a shrunk-on fit with minimum effort. Product and bushing slip on the shaft as a unit. Tighten the screws—and you're set!

# Save Money!

You save big money by minimizing down-time with quick changes. And interchangeability minimizes inventory. Note that all of the above installations are handled with a total of only four bushings—all with the same outside diameter!

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CALL THE TRANSMISSIONEER—your local Dodge Distributor. Fectory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look in the white pages of your telephone directory for "Dodge Transmissioneer".

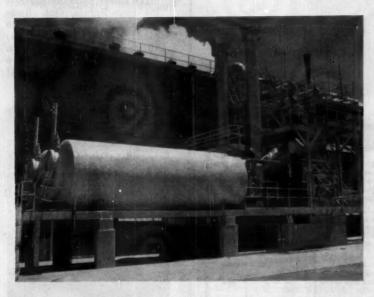


DODGE MANUFACTURING CORPORATION, 200 Union St., Mishawaka, Ind.

# FIRMS IN THE NEWS

**NEW FACILITIES** 

R. A. LABINE



### Carbide Ships Preassembled Plant to Mexico

Union Carbide Olefins Co. recently delivered an assembled solvent recovery unit to Celanese Mexicana's acetate yarn plant at Ocotlan, Jalisco. Unit was assembled and inspected by Carbide engineers in U. S. and then dismantled into four sections for loading on railroad flatcars. Air flow capacity is 17,000 cfm.

B. F. Goodrich is turning out a versatile thickening and emulsifying agent called Carbopol in a new \$3-million facility at Calvert City, Ky. Rated capacity is 70,000 lb./mo. of the fluffy white powder.

Air Reduction Co. has started construction on its new 20-million-lb./yr. polyvinyl alcohol resin plant at Calvert City, Ky., and a supporting pilot plant at Bound Brook, N. J. Projects will cost over \$12 million and are expected to be on stream by early 1960.

Union Carbide Chemicals is in design stage on two projects that will add 100 million lb./yr. alcohol and ester production to its Seadrift, Tex., manufacturing complex. Completion date for the new units is set for some time in 1960.

Celanese is boosting acetic acid output at firm's Pampa, Tex., plant by 240 million lb./yr. Work on the multimillion-dollar expansion is starting immediately and is expected to be completed by late 1959; addition will bring combined capacities of the Bishop, Tex., and Pampa plants to more than one-quarter of nation's acetic acid capacity.

Anilin Co. of Illinois is erecting a 150-ton/day plant to recover sulfur from hydrogen sulfide piped from Shell's adjacent Wood River, Ill., refinery. Cost—around \$2 million; completion date—middle of 1959.

American Potash & Chemical Corp.'s new sodium chlorate plant at Aberdeen, Miss., is expected to begin production late this year, right on sched-





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STEEL CONVEYOR PULLEYS
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#### Write for Bulletins!

- Flexidyne Dry Fluid Drives and Couplings. Bulletin A-640-A.
- Taper-Lock Steel Conveyor Pulleys.
  Complete data. Bulletin D-56.
- Rolling Grip, Diamond D, Air-Grip Clutches. Bulletin D-56.

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DODGE

of Mishawaka, Ind.

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85 to 100% of your corrosion-resistant piping needs now available from 1 source

- THE NEWEST OF MATERIALS
- BACKED BY 100 YEARS OF EXPERIENCE

TYPE	SIZES	PROPERTIES	VALVES	ASK FOR BULLETIN
1 ACE-ITE	Threaded Pipe 1/2 to 6"	General purpose rubber-plastic blend. Tough, impact resistant, economical. Han- dles most common chemicals to 170°F.	Diaphragm valves with Ace-ite body, ½ to 2"	80-A
RUBBER-LINED 2 STEEL	Flanged Pipe 1½ to 24" and up	Strength of steel, resistance of hard rub- ber. Soft-rubber inter-layer aids shock- resistance. Finest for alkalis, most inor- ganic acids, many organic acids, all salts.	Rubber-lined C.I. Gate, Darling Gate & Check Valves to 24". Diaphragm Valves to 6"	CE-52
ACE TEMPRON	Threaded Pipe 1 to 8"	Best anywhere for hot inorganic chemicals, acids, etc. to 260-275°F. Also wide variety of organics. Excellent rigidity.		96-A
ACE RIVICLOR	Threaded Pipe 1/2 to 4"	Rigid PVC. Excellent aging. Good cold impact strength. Not affected by most inorganic acids and alkalis. Also good for many organics.	Diaphragm valves with Riviclor body ½ to 2"	CE-56
ACE PARIAN	Threaded Pipe ½ to 2"	Odorless, tasteless, rigid polyethylene, best for sub-zero uses. Best resistance of any plastic at room temp. except to acetic acid.	Diaphragm valves with Parian body, ½ to 2"	381
ACE HARD RUBBER	Threaded 1/2 to 4" Flanged 11/2 to 8"	The oldest, still tops. Extreme resistance to alkalis, inorganic acids, many organics, all saits, ideal for chlorine, fluorine. Widest range of fittings.	Rubber-lined or plastic valves above. Also many plug valves, bibb cocks, etc.	CE-51
ACE SARAN	Threaded Pipe ½ to 4" Tubing ¾ to 1¼4"	Odorless, tasteless, general-purpose. Strong, takes high pressures. Not affected by most inorganic acids and aikalis; re- sistant to most organics.	Diaphragm Valve with Saran body 1/2 to 2". Also Saran-lined diaphragm valves to 6" and up	CE-58
ACE- FLEX	Flexible Tubing 1/6 to 11/4"	General-purpose transparent flexible tub- ing. Non-toxic, odorless, tasteless. Can steam sterilize. Excellent for chemicals.	Ace hard rubber plug valves, bibb cocks, etc.	66
SUPPLEX	Flexible Pipe 1/2 to 2"	Non-toxic flexible polyethylene pipe. Ideal for water distribution lines, drain lines, jet wells, etc. Resistance similar to Parlan. Uses insert type fittings.	Diaphragm valves with Parian body, 1/2 to 2"	CE-57

11/31

RUBBER AND PLASTIC LINED TANKS, PUMPS MOLDED PARTS ETC. FOR ANY NEED

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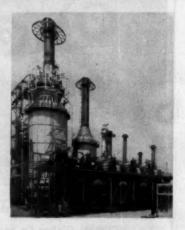
ACE Saran, Supplex, Ace-ite and Rivicior are approved by The National Sanitation Foundation for drinking water.

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FIRMS .

ule. Capacity will be 15,000 tons/yr.

Du Pont of Canada has started construction on a plant to make linear polyethylene resins near Sarnia, Ont. Rawmaterial ethylene will be piped from nearby Imperial Oil petrochemical plant in Sarnia. Also under way is a new polyethylene film plant near Toronto.



Esso has placed "world's largest" (27,000-bbl./day) Powerforming unit on stream at its big Baton Rouge, La., refinery. Unit is part of a \$46-million capital improvements program at the refinery.

Shell Chemical Corp. will start construction early in 1959 on a phenol unit at its Deer Park, Tex., plant. Construction contract has been awarded to M. W. Kellogg; unit will be completed in late 1959. Most of output is earmarked for firm's adhesive and surface coating resins.

Pittsburgh Plate Glass has started site preparation at Crestline, Ohio, for its new tempered glass plant. Factory building will cover 275,000 sq. ft.; about 275 workers will be employed.

Monsanto has gotten court clearance for its 11-mi. black top road from elemental phosphorous reduction plant at Soda Springs, Idaho, to opencut phosphate rock mine on the Black Foot River. Court action was initiated when one property owner refused to grant right-of-way.

Western Phosphates will spend \$500,000 expanding its Garfield, Utah, facility for producing several new phosphate-ammonia fertilizer formulations. Phosphate ore input to plant will be increased by around 10%.

Air Reduction has a \$600,000 oxygen-nitrogen plant under way at Denver, Colo. Plant, Airco's first in the area, will be in operation by Jan. 1, 1959.

U. S. Borax & Chemical is increasing boric acid production at Wilmington, Calif., after receiving contracts from two major boron fuel producers—Olin Mathieson and Callery Chemical.

Bay Refining will add 750-bbl./
day hydrofluoric acid alkylation unit to its Bay City,
Mich., plant. Unit will use
Universal Oil Products process; Sweco has landed engineering and construction
contract.

Hoke, Inc., manufacturer of precision fluid control products, has completed new 64,000sq.-ft. plant in Cresskill, N. J. Among products: valves, pressure regulators, stainless steel cylinders and gages.

Canadian Chemical Co. is launching a \$600,000 program to boost production at the yarn division of its Edmonton, Alta., plant. Spinning capacity is expected to be increased by about one-third.

Atlas Powder Co. is consolidating all its eastern explosives production activities at the recently modernized Reynolds Plant near Tamaqua, Pa. As a result, the smaller plant at White Haven, Pa., will be shut down at year's end.

St. Eloi Corp., Cincinnati, Ohio, has expanded its rare metals facilities, making metals such as yttrium, scandium, and

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Diamond Alkali plans to build a multimillion-dollar campus-style research center a few miles south of Painesville, Ohio. Initial construction phase calls for three buildings for central research and development costing around \$3 million.

Hercules Powder Co. disclosed that it has bought 1,800 acres along the Delaware Bay, about one mile north of Lewes, Del. Spokesman said firm has no immediate plans for the property but desires an available site for possible future expansion.



Anaconda has set up a new subsidiary, Anaconda-Jurden Associates, built around the existing engineering department of the parent company. New organization offers complete service in planning, designing, engineering and construction of large industrial plants. Headquarters are in New York.

Petroleum Chemicals plans to set up a development department to work on production of intermediates used in making synthetic fibers, plastics and elastomers. New chemicals will be based on firm's present production of butadiene, ethylene, propylene and ammonia.

James M. Margolis has established a new chemical marketing research service in New York. Firm has been concentrating on chemical specialties, particularly in plastics and pharmaceuticals.

Dow Chemical has formed a new overseas subsidiary, Dow Chemical International, to



# Which ones do you want licked?

They're all sour-when you have to pump corrosives. You can lick all four when your pump is made of the right materials.

You know what you have to pump. We know how to furnish pumps to handle it.

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... a new name in scientific instrumentation which will soon rank among the foremost in the field ...

Bayer Farben of Germany have over the years developed for their own use a variety of unique testing instruments for production control and laboratory apparatus for the purpose of meeting contingencies for which suitable equipment was not available commercially.

This equipment is now manufactured by the Agfa Camera Works, a subsidiary, under whose well-known trade name the instruments are marketed. It gives us great pleasure to announce that the Brinkmann organization has been entrusted with the introduction of this equipment in the United States.

American industrial firms now have a unique opportunity of benefiting, at comparatively reasonable cost to themselves, from the results of many years of concentrated efforts by some of the world's greatest teams of workers in their respective fields.

### A twenty-page brochure on the following equipment may be obtained from us:



- Rotating Viscosimeters
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   —60 to + 250°C.
- Testing Apparatus for determining stability under pressure of materials such as rubber, metal-rubber, elastic or semi-elastic plastics, etc.
- Bi-axial Alternate-Stress Testing Machine for rubber and plastic diaphragms.
- Vulcameter, for the recording of the vulcanization curve of rubber compounds.

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handle its foreign operations. Dow International has opened offices in Caracas, Venezuela.



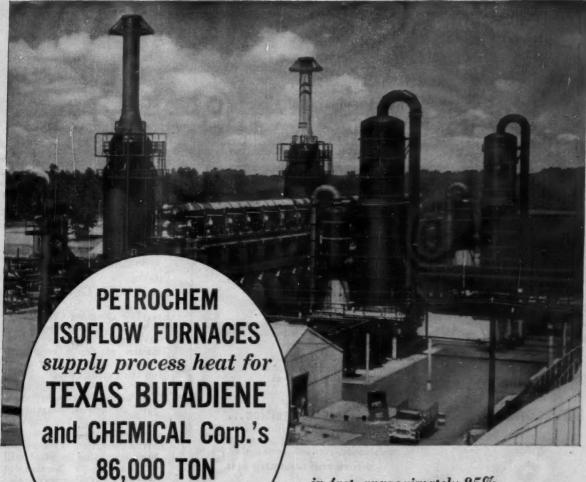
Worthington Corp., Harrison, N. J., is changing its trademark, symbolic of the sweeping corporate re-alignment that company is undergoing. Old winged trademark is being replaced by a massive "W."

Cities Service Co. recently filed with the Securities Exchange Commission a plan for splitting Arkansas Fuel Oil Corp. into two separate companies: Firm would own one and present minority stockholders in Arkansas Fuel Oil would own the other company. Plan was filed in compliance with SEC ruling that Cities Service must dispose of its majority interest in Arkansas Fuel Oil or else eliminate the minority share.



National Aluminate Corp. is acquiring business and assets of Oil Products & Chemical Co. and it will continue as a division of National Aluminate. Main products marketed by Oil Products & Chemical are specialized lubricants used in cold rolling, drawing, cutting and forming of steel.

Industrial Instruments, Cedar Grove, N. J., recently acquired Mosher Electronic Controls of Larchmont, N. Y. Mosher previously had been



... in fact, approximately 85% of all new butadiene capacity in the U.S. is processed through Petrochem "Isoflows."

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short flame combustion
...even on residual fuel oil

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Here is a versatile unit that gives rapid, clean combustion on a wide range of fuels including Bunker C, No. 6, light oil, any gas...even liquid organic wastes.

Combustion is 80% completed within the burner itself and takes place with a whirling, short flame that attains heat release rates of over 1,000,000 BTU/hr per cu ft. Products of combustion are clean and sufficient excess air for tempering the products may be introduced through the burner itself without causing smoke or instability.

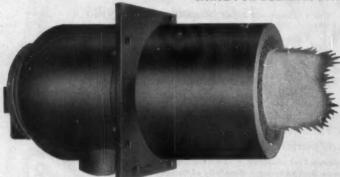
standard models available...

Complete units from 3,500,000 BTU/hr to 50,000,000 BTU/hr are available and may be fitted for steam, compressed air or mechanical atomization. With dual fuel arrangements switching from gas to oil is accomplished without shutdown.

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handling applications engineering and sales of controllers manufactured by Industrial Instruments.

Daystrom, Inc., has purchased Industrial Gauges Corp., West Englewood, N. J., in a cash transaction. Industrial Gauges is manufacturer of non-contact measuring gauges.



Ever-Tite Coupling Co. has appointed Shields-Harper & Co., Oakland, Calif., as distributors of firm's couplings, adapters and other products on the Pacific Coast.

M. W. Kellogg is now exclusive sales and licensing agent for new process for making sponge iron via natural gas or oil reduction. Process has been operating in steel mill of Hojalata Y Lamina in Mexico on 200-ton/day scale; Kellogg is now engineering a 500-ton/day plant.

Bowen Corp. of Canada has signed a long-term exclusive sales agreement to handle all sales and promotion of American Dynamics' Hykinator, a new leak-proof pump. Agreement covers both U. S. and Canada.

Alvey Conveyor Mfg. Co. has appointed the Robert H. Braun Co., Los Angeles, as southern California representatives. Braun maintains complete sales, service and maintenance facilities for materials handling equipment.

Spence Engineering Co., Walden, N. Y., announces appointment of R. C. Beckert Co., New York, as sales representative for Spence Engineering's equipment in New York City and northern New Jersey.

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CHEMICAL ENGINEERING-October 20, 1958

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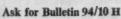
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Also important in many processes, this Neptune meter ends many problems caused by contamination of liquids being measured.

Based on the reliable Neptune positive displacement principal, its accuracy is completely protected from the effects of corrosion or corrosive wear. There are only two moving elements in contact with the liquid. The gear-train is mounted outside the casing, isolated from the liquid.

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# **CALENDAR**

American Institute of Chemical Engineers, New York Section, all day symposium: Cost Engineering, Foams and Froths, Trade Secrets and Patents, Petroleum Chemicals; luncheon speaker: George Holbrook, Hotel Statler.
Oct. 23 New York, N. Y.

National Society of Professional Engineers, fall meeting, St. Francis Hotel
Oct. 23-25 San Francisco, Calif.

National Metals Exposition, Cleveland Public Auditorium. Oct. 27-31 Cleveland, Ohio

Assn. of Consulting Chemists and Chemical Engineers, annual meeting, Biltmore Hotel. Oct. 28 New York, N.Y.

Armour Research Foundation, Computor Application Symposium, Morrison Hotel.

Oct. 29-30 Chicago, Ill.

National Agricultural Chemicals Assn., 25th annual meeting, Bon Air Hotel. Oct. 29-31 Augusta, Ga.

American Society for Quality Control, 12th annual New England Conference, Wendall Sherwood Hotel. Oct. 30-31 Pittsfield, Mass.

American Society of Testing Materials, international symposium: Plastics and Standardization, Benjamin Franklin Hotel.
Oct. 30-31 Philadelphia, Pa.

American Institute of Chemical Engineers, North Jersey Section, Topic: Engineering Education, General Chemical Division, Allied Chem. & Dye.

Nov. 4 Morristown, N. J.

Society of Plastics Engineers, Philadelphia Section, Topic: Advances in Injection Molding, Sheraton Hotel.

Nov. 6 Philadelphia, Pa.

National Academy of Sciences, fall meeting, University of California. Nov. 6-7 Berkeley, Calif.

Society of Plastics Engineers, South California Section, Topic: Plastic Trends in Building Construction, Ambassador Hotel. Nov. 13 Los Angeles, Calif.

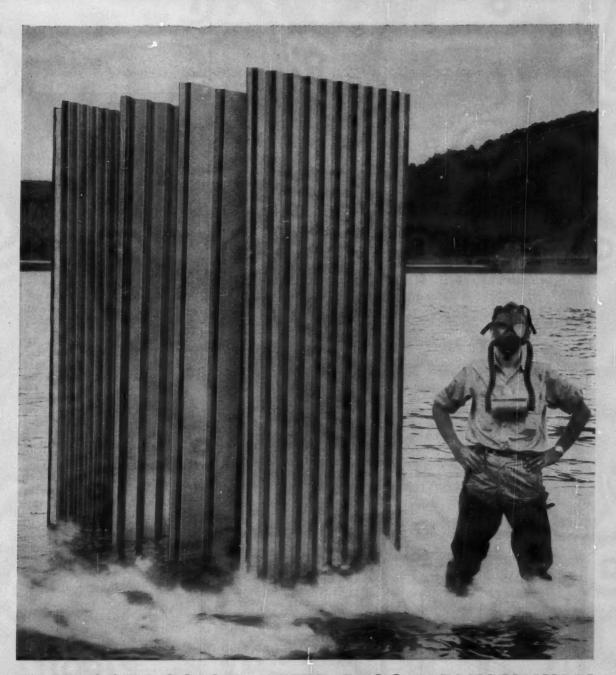
National Assn. of Corrosion Engineers, Western Region Meeting, Hotel Statler. Nov. 17-19 Los Angeles, Calif.

Society of Plastics Industry, 8th National Plastics Exposition, Morrison Hotel and Chicago Amphitheater.

Nov. 17-21 Chicago, Ill.

Department of Health, Education and Welfare, National Conference on Air Pollution, Sheraton Park Hotel. Nov. 18-20 Washington, D. C.

American Society of Mechanical Engineers, 23rd National Power Exposition, New York Coliseum.
Dec. 1-5 New York, N Y.



# BEAT CORROSION WITH ALCOA ALUMINUM!

Moisture, chemical fumes, industrial atmospheres are no problem with Alcoa® Aluminum industrial building products. They defy corrosion. Never need costly painting or maintenance. First cost is last cost with aluminum!

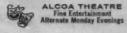
And you have a choice. Alcoa Corrugated for economical roofing and siding. Alcoa V-Beam for high strength with a uniform load of 30 psf on a span of 12 feet. Alcoa Ribbed for clean-lined, good-looking buildings. And

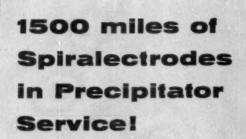
for the lowest cost insulated metal wall system known—sandwich wall of Alcoa Aluminum with three times the insulating value of 8-in. brick!

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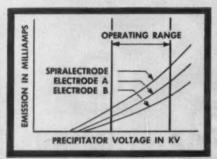


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Over 1500 miles of these emitting electrodes have been installed in 'SF' electric precipitators . . . delivering 50 to 100% more electron emission than conventional types of electrodes.

There are sound reasons why Buell *Spiralectrodes* are providing superior emitting efficiency in actual dust collecting applications.

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- Spiralectrodes' controlled area emission stops sparking effect of "point emission."



Above chart illustrates the superior emission of the Spiralectrode: its corona voltage is lower and its emission is higher than other types of emitting electrodes over the entire operating range of industrial precipitator voltage.

The superior operating characteristics of Spiralectrodes contribute to continued high efficiency of Buell 'SF' Precipitators. Detailed information of this and other exclusive features are described in a booklet, "Buell 'SF' Electric Precipitators." Send for your copy: write Dept. 12-J, Buell Engineering Company, Inc., 123 William Street, New York 38, New York.



Experts at delivering Extra Efficiency in

### DUST COLLECTION SYSTEMS

NEW EQUIPMENT . . .

(Continued from page 88)



Nitrogen Generator

Economical for moderate liquid nitrogen demands.

At the push of a button, the new ADL liquid-nitrogen generator system starts automatic production of up to 95 1./day of 99.5%-pure product. The manufacturer claims economical operation for all users requiring less than maximum capacity.

Major system components include a packed column, a Norelco gas liquefier and a 200-1, storage tank. In operation, oilfree air passes from the heat exchanger, which removes water and carbon dioxide, into the rectifying column. Nitrogen gas leaves the top of the column and enters the condensing head of the liquefier. Here, the product liquefies and non-condensibles continuously bleed off. Some nitrogen liquid returns to the column as reflux; the remainder goes to storage.—Arthur D. Little, Cambridge, Mass. 198F

#### Electric Motors

Three companies market models for wet service.

Among the motor developments of the past few weeks, three manufacturers introduced new lines especially designed for extreme service. One motor operates while completely submerged, the other two provide reliable service under all weather conditions.

General Electric's contribution, a motor designed for use while totally submerged, owes its ability to a new insulation system incorporating irradiated polyethylene. Anticipated markets rely mainly on applications as underwater drives or integrated pump-motors. Units of 250 and 350 hp. are now in production for high-pressure boiler circulation use; minimum rating will probably be 100 hp.—General Electric Co., Schenectady, N. Y.

Available in ratings from 250 to 2,000 hp., Louis Allis' new line of vertical motors is claimed to be unaffected by driving rain or snow, hurricane winds, or wind-blown sand. All sizes meet NEMA Type II Weather Protected specifications. Offered with either solid- or hollow-shaft construction. Louis Allis Co., Milwaukee, Wis. 198C

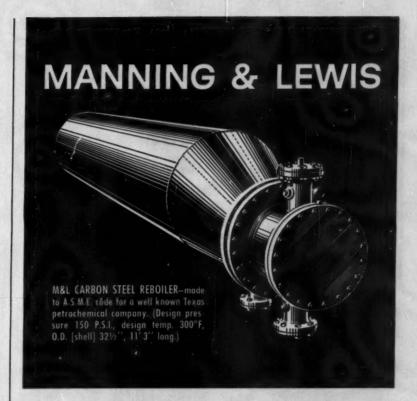
Engineered throughout to meet the punishment of extreme moisture or the elements, Reliance's new weatherproof motor comes in all standard speeds and in ratings from 1 to 250 hp. A special thermosetting oil-andwater-resistant varnish coats all wire coils. The motor exceeds NEMA splash-proof requirements.—Reliance Electric and Engineering Co., Cleveland, Ohio.



Gas Burner

For sealed-in firing of furnaces and kilns.

Exceptional flame stability, even with 1,000% or more excess air, is just one characteristic claimed for the new Hauck burner. Others include excellent control of flame temperature and positive igntion at any



Today's rapid strides in the technology of processing plant operation make it essential for a manufacturer of equipment to be "staffed up" with people who have had extensive training and experience. More than half our staff have spent a major part of their working life in this one field and have played a major role in the design and fabrication of many types of processing equipment. They know the limitations and workability of all metals and how to get maximum service from each. This accumulated knowledge of base materials and our extensive experience in design and fabrication means practical, trouble-free equipment at the lowest possible cost.

It is impossible, in a field requiring such wide diversification, to illustrate, or even list, all the products we have been called upon to supply. The reboiler above is simply one among thousands.

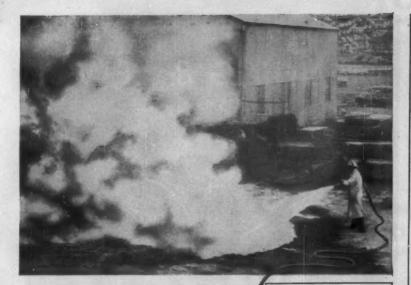
Call on us the next time you need equipment. We are fully qualified to design and fabricate to all codes.



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DESIGNERS & MANUFACTURERS OF QUALITY HEAT EXCHANGE EQUIPMENT



# NEW!

# **One-Man Dry Chemical Kills More Fire Faster!**

This new Kidde pressurized 200-pound extinguisher gets more fire-smothering dry chemical on a blaze faster! Its universal

nozzle discharges a dense 40-foot stream that gives more efficient extinguishing action, greater heat protection for operator.

It has an extra 50 pounds of dry chemical to discharge on any stubborn blaze. Not 150 pounds, but a full 200 pounds of dry chemical - a 33\\% bonus for safety! Yet its total weight is less - no heavy, cumbersome gas cylinder.

It's faster to operate too. No valves to unscrew. No wait for pressurization, for dry chemical to fluff. No pressure reducer to malfunction. Just remove safety pin, swing valve toggle, and flip "on-off" nozzle lever. There's no hose whip either.

Only Kidde has the Bridgeman seal head assembly. When pressurized at 450 psi with nitrogen or dry air, an inner force of three tons acts on the seal - the more pressure, the tighter seal. Virtually leakproof, tamper-proof.

Check these other benefits. A low, balanced center of gravity, wider handle, compact design, and larger, lubricated wheels make it easy to move. It's weather and corrosion protected. And the shielded dust-and moisture-proof pressure gauge tells at a glance this extinguisher's readiness for action.

Write Kidde today and get the full story on this new U.L.-approved One Man Fire Engine.





Walter Kidde & Company, Inc.

NEW EQUIPMENT . .

burner setting for either hot or cold furnaces. In addition, high forward velocities of the hot combustion gases affect a better distribution, circulation and penetration of furnace heat.

Both burner nozzle and body feature heat-resisting alloy construction; tile is super refractory. Entire assembly, consisting of burner body, tile and box-type mounting plate, installs with the air inlet at any one of four 90-deg. quadrants. -Hauck Mfg. Co., Brooklyn,



#### **Enclosed Screen**

Designed for maintaining clean, healthful plants.

New Ripl-Flo screens, either single- or double-deck, feature stationary frame enclosures having side doors and top covers for easy access to all interior parts. For dust-free operation, the totally enclosed units also have provision for bolting fines hoppers to the supporting frame. And, exhauster outlets can be provided in the enclosure bolted to the discharge spouting.

All screens come with air springs. Several units, in the 6 x 16-ft. and 5 x 16-ft. sizes are now finding application in various cement plants.—Allis-Chalmers Mfg. Co., Milwaukee,

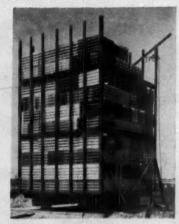
#### Diaphragm Pumps

Built to withstand rugged service conditions.

Especially designed to handle corrosive liquids and slurries, a new series of single- and double-stage diaphragm pumps covers a wide range of working pressures and capacities. Outputs of nine standard models range from 2.5 to 35 gpm. at

115 psi.; maximum working pressures range to 230 psi. Drive-motor sizes vary from ½ to 12 hp.

Simplicity and durability of design are the keys to a long service life with a minimum of downtime for repairs. In operation, a piston moving in a cylinder creates alternating pressure and vacuum on one side of a diaphragm. Resultant motion of the diaphragm transfers pressure changes to the liquid being pumped. Other than the diaphragm, the only moving parts contacting liquid are the spring-loaded ball check valves controlling liquid flow. -Schweitzer Equipment Co., Cleveland, Ohio.

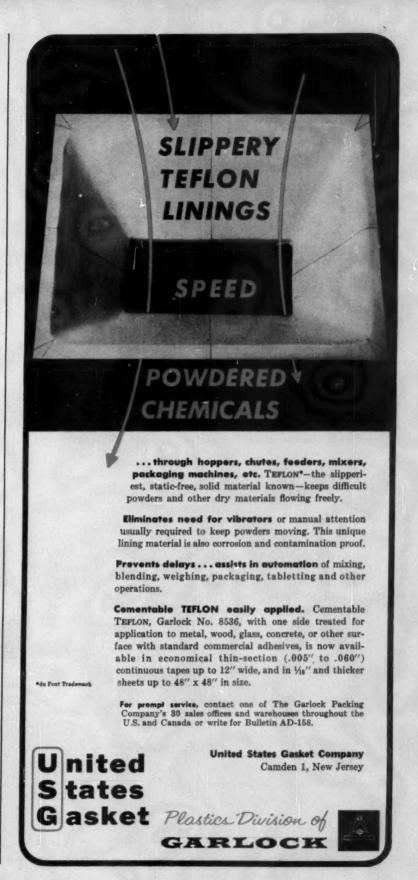


Plastie Packing

For biological oxidation of liquid wastes.

Plastic packing, consisting of separated layers of corrugated polystyrene or Saran sheets, provides large surface areas to which waste-treating bacteria can adhere. In addition, the corrugated shape permits high air flow through the packing to supply the bacteria with necessary oxygen. As such, the packing provides near-ideal conditions for biological treatment of liquid wastes.

Known as Dowpac, the new product has a major advantage compared to conventional rock packing—it weighs only 1/20 as much. Whereas rock packing is limited to large ground locations, Dowpac stacks into piles up to 42 ft. high. Thus, a





This is part of an actual memo sent by one plant manager to others of the same company in different sections of the countryand that company is now exclusively specifying these and other type "John Crane" Shaft Seals for all their liquid handling requirements.

HOURS."

You too can save time, trouble and expense by doing likewise.

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Send us details on your application. We'll recommend the proper shaft seal. Request Bulletin S-204-3 for complete overall information.

Crane Packing Co., 6451 Oakton St., Morton Grove, Illinois, (Chicago Suburb).

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vy duty, high pressures. Par aged construction for easy installation. Handles pressures to 1200 psi., temperatures from -40°F. to +250°F. Services same as Type 1.



Sealing members of che inert Du Pont Teflon. Eng ally all destruct corrosives and gases at tempera-tures from -120°F, to +500°F, pressures to 150 psi. Available in balanced construction for pres-















PACKING COMP

NEW EQUIPMENT . . .

much smaller ground area, as well as a simplified drainage is required. - Dow Chemical, Midland, Mich. 201A

#### Tare-Out Control

System ends variable container problems.

A new, automatic taring-out system makes it possible to rapidly fill a variety of containers with consistent amounts of material, regardless of container weight. According to the manufacturer, the system eliminates any possibility of human error. Although somewhat dependent on load weights, normal speed of operation is about 2 cycles/min.

When the start button is pressed, an impulse to the material feeder adds the specified load to the container on the weight platform. After the dialed weight has been added, another impulse activates the conveyor system, which removes the filled container and replaces it with an empty. Compensation for container weight is auto-matic. The cycle repeats itself until operator presses the stop button.—Richardson Scale Co., Clifton, N. J. 202A

#### Remote Transmitter

Generates 3-v. signal; uses no external power.

Though now offered only as an integral part of a household water meter, some modifications of a newly developed transmitter may hold much in store for the process industries. Heart of the Read-O-Matic is a selfcontained generator-no electrical connections to a power source, no batteries. Thus, the unit may be adaptable to industrial remote readout of flow and liquid level.

Operation is precise and almost foolproof. Fluid passing through the meter rotates a magnet mounted on a drive-gear segment. When the segment "runs out of teeth," a torque spring snaps the magnet back to its starting position. In doing so, the magnet generates a pulse

as it passes over six closemounted coils. The 3-v. pulse travels by wire from transmitter to register.—Badger Meter Co., Milwaukee, Wis. 202B

#### BRIEFS

Pulsation dampener effectively smooths out pressure surges in the discharge line of any reciprocating pump. Body is cast alloy steel to withstand rough field handling.—Ball Mfg. Co., Torrance, Cal. 203A

Furnace thermocouples, installed in tube walls, measure increase in outer wall temperature when heat transmission falls off because of coking or scaling of the inner wall.

Operating range of 700-1,800
F.—Thermo Electric Co., Inc., Saddle Brook, N. J. 203B

Absolute pressure transmitter, accurate to 0.5% of full scale, produces a 3-15 psi. linear signal. Maximum operating temperature is 250F. Parts exposed to process fluids are Type 316 stainless.—Foxboro Co., Foxboro, Mass. 203C

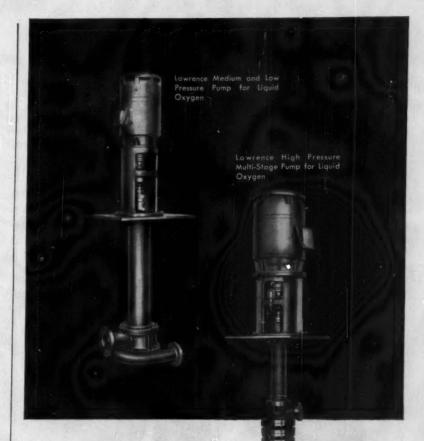
Silicon rectifier for all types of power applications provides average forward currents to 160 amps. per cell in single-phase circuits, or 150 amp. in 3-phase service. Maximum peak inverse ratings to 500 v.— Westinghouse Electric Corp., Pittsburgh, Pa. 203D

Multiwall bag with single-gusset, sewn-valve construction stacks uniformly when filled for easy palletization. Improved performance on the packer reduces packaging time and labor requirements.

—Bemis Bros. Bag Co., St. Louis, Mo. 203E

Water filter removes sand, silt, metal and algae as small as 10-20 microns from water with high reliability and low cost. Capacity is 1,000-2,500 gal./hr.—Klemm Automotive Products, Chicago, Ill. 203F

Valve actuators, for conversion of 3- to 15-psi. instrument air pressure into high-torque



# PUMPS

# to handle LIQUID OXYGEN and other LIQUEFIED GASES

Lawrence Pumps Inc. has developed a special line of pumps for handling liquid oxygen, liquid nitrogen and other gases which can be liquified only at very low temperatures.

Because of the abnormal behavior of materials and liquids at extreme low temperature several of the following features are incorporated in these pumps:

- Vertical top suction construction to prevent gas binding when the NPSH drops below the safe level, due either to drop in suction pressure, or rise in temperature of the liquid.
- 2. The packing box does not come in contact with the liquid, only with the blanket of gas in the pipe column.
- The packing box is fitted with a mechanical seal which has been developed especially for this exacting service.
- 4. The design has been carefully developed and the materials selected to eliminate any troubles due to differences in expansion and to prevent galling between running parts.



Write for bulletin 203-7



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371 Market Street, Lawrence, Mass.

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force for operating 90-deg.rotation valves, come complete for quick field installation. Square boss on actuator shaft permits manual operation.—Bettis Corp., Houston, Tex.

Temperature recorder has a sensitivity and accuracy of 0.001 deg. C on a full scale of 0.5 deg. A switch selects any 0.5-deg. observation span within the operating range of 20 to 30 C.—Fenwal Electronics, Inc., Framingham, Mass. 204A

PVC fittings and flanges are now available for 6-in. piping. Capable of withstanding high pressures, the molded unplasticized units cost 50% less than lined steel pipe.—Tube Turns Plastics, Inc., Louisville, Ky. 204B

### **Equipment Cost Indexes...**

	March 1958	June 1958
Industry		
Avg. of all	231.2	230.7
Process Industries		
Cement mfg	222.9	222.2
Chemical	232.4	231.7
Clay products	216.6	216.0
Glass mfg	219.4	218.8
Paint mfg	223.8	223.1
Paper mfg	223.9	223.3
Petroleum ind		227.9
Rubber ind	231.4	230.7
Process ind. avg	228.8	228.2
Related Industries		
Elec. power equip	234.2	234.3
Mining, milling		233.1
Refrigerating		260.7
Steam power		218.4

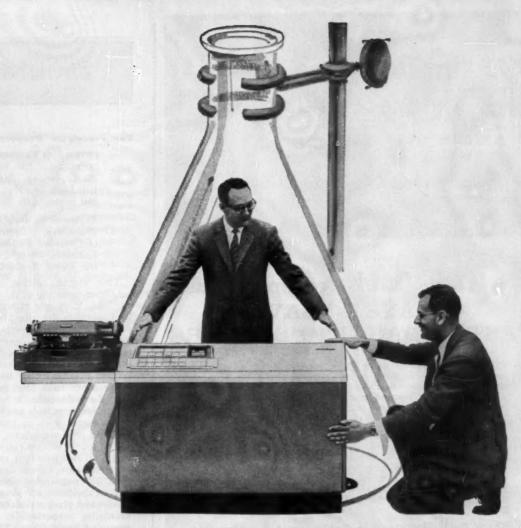
Compiled quarterly by Marshall and Stevens, Inc. of Ill., Chicago for 47 different industries. See Chem. Eng., Nov. 1947, pp. 125–6 for method of obtaining index numbers; Feb. 24, 1958, pp. 143–4 for annual averages since 1913.

#### For More Information . . .

about any item in this department, circle its code number on the

#### Reader Service

postcard (p. 217)



# Take the tedium out of correlation studies with this powerful electronic computer ROYAL PRECISION LGP-30

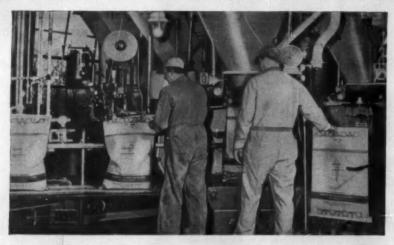
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Compact, simple to use . . . Royal Precision LGP-30 brings high-speed electronic computation right to your desk . . . relieves you of the tedium of statistical analysis in such areas as research and product development, quality control and process control. And at the lowest cost ever for a complete computer system!

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# Richardson, recommends 4 WAYS TO SAVE WASTED BAGGING DOLLARS

- 1. Minimize Weight Give-Away. Frequently, you're forced to set mean bagging weights high, to prevent falling short. With an inaccurate scale, you can lose more than \$10 an hour through weight variations—especially when bagging at high speeds. Many processors have solved this problem by installing Richardson bagging scales. With average accuracy of ± 1 to 2 oz. or better, they prevent overweights and underweights, year after year.
- 2. Spend Less for Bags. You may be paying good money for nothing but "air space" in filled bags. A Richardson G-73 Impacker can end this waste. The Impacker is a simple, compact accessory that quickly "shakes down" material as it fills bags. Thus, you can pack any given quantity into smaller, neater bags. The money you save—on bag size alone—can bring you profits well beyond the cost of this equipment.
- Speed Up Production. Example: the Duplex Richardson E-50
  Bagging Scale can turn out twenty 100-lb. bags per minute. It's
  only one of many Richardson models for handling flour, sugar, rice,
  feed, and chemicals, in bagging ranges of 25-250 lbs.
- 4. Cut Excessive Labor Costs. Are your bagging operations overmanned? Some installations require expensive standby labor. You can cut out this cost-sometimes as much as one-third of regular labor costs-and free labor for productive work, by installing automatic Richardson bagging equipment. Time and labor-saving accessories include automatic feeders, sewing conveyors and pedestals, bag-holders, as well as packers like the Impacker described above. Low-cost automatic proportioning systems are Richardson specialties, too. Simple design makes maintenance easy. Any maintenance man can understand a Richardson. And, only Richardson maintains a nationwide service organization that can serve you within 24 hours, if necessary.

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# TECHNICAL

#### For Petroleum Properties

PETROLEUM REFINERY ENGINEERING, 4th ed. By W. L. Nelson. McGraw-Hill Book Co., New York. 960 pages. \$15.

Reviewed by Dale U. von Rosenberg, Department of Chemical Engineering, Louisiana State University, Baton Rouge, La.

This fourth edition is primarily an updating of the earlier editions. Most new material has been added to describe processes developed since the previous edition or to give properties of crudes or products which have attained importance only recently. Practically no additions or revisions have been made to describe advances in fundamentals or new tools available to the engineer such as numerical analysis and computers.

The fourth edition can be generally divided into four sections. First of these, comprising more than 200 pages, describes tests and evaluations of stocks and crudes and gives correlations for obtaining properties of petroleum and its products. This section has been expanded from earlier editions to include more crudes and products, particularly those from other countries.

Some 400 pages are used to describe refinery processes, including descriptions of new cracking and reforming processes. The treatment here seems adequate to acquaint the reader with the objectives of various processes and to provide him with flow diagrams of the processes.

Chapters on various unit operations seem to be unnecessary. These operations, such as fluid flow and heat transfer, have been treated much more completely in many basic chemical engineering texts. The material presented is inadequate to give the reader an understanding of the fundamentals involved. Thus, he must either consult another text or blindly use the techniques and formulas provided. The section on fractionation makes little or

# BOOKSHELF

J. B. BACON

no mention of the computer techniques which are used extensively by today's refiners.

A short section on economics and design calculations completes the book. These were included primarily to outline the basic features of such calculations, and appear to be satisfactory in this respect. However, again, little or no information is given concerning the highly important blending calculations made on high-speed computers.

In short, the fourth edition is an excellent source of information for properties and tests of petroleum and its products, and it contains descriptions of today's refining processes.

#### Nuclear Engineering

INTRODUCTION TO NUCLEAR ENGINEERING. By Richard Stephenson. McGraw-Hill Book Co., New York. 491 pages. \$9.50.

Here's a healthy addition to McGraw-Hill's Nuclear Engineering Series. This second edition of Stephenson's primer in nuclear engineering is an enlarged and revised version of its predecessor. New material has been added that was released in the broad declassification program of 1957 and the whole book has been reorganized to present the material in a more logical manner.

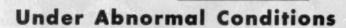
The first edition of the book proved so useful that the Russians stole it and published it in their own tongue. McGraw-Hill Book Co. has republished the first edition in English at its Tokyo office for the Asian World.

A Good Perspective — Emphasis remains on those engineering principles that are unique to the nuclear engineering field. A brief review of nuclear physics leads into reactor theory and technology. First a smattering of general reactor theory, then a survey of reactor technology and finally an extensive treatment of reactor





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#### BOOKSHELF . . .

theory is an ideal arrangement of material. It results in a good perspective of the theory when the reader is all done.

Allied topics such as radiation shielding, materials of construction and instrumentation and control receive extensive treatment, with plenty of sample problems for engineering practice. Chemical processing and isotope separation are touched on, too.

Two New Chapters—Two entirely new chapters have been added to the text; one on reactor core design handles the heat-transfer aspects of reactor design; another on thermonuclear power is a fine introduction to theory tied to this field, although it lacks the technology just released at Geneva this fall.

Although this volume is written as a text to introduce the engineer to nuclear engineering, it remains a valuable reference to anyone working in the field who has to refresh his knowledge of theory.—JAK

#### BRIEFLY NOTED

CATALOGS OF TECHNICAL REPORTS. Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. 10¢ each. List all research reports available from OTS collection in the fields of molded plastics (report CTR-347, covering 1938-1958), polystyrene (CTR-346, 1930-1958), zirconium (CTR-344, 1932-1958), anodic coatings (CTR-348, 1934-1958) and greases and lubricants (CTR-345, 1939-1958).

HOT LABORATORY BULLETIN. 429 pp. Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. \$2.50. Gives descriptions and design data for facilities and accessories used in handling moderate to large amounts of radioactive materials; treats such subjects as chemical-processing and materials-handling equipment.

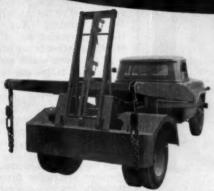
#### MORE NEW BOOKS

GLASS ENGINEERING HANDBOOK, 2nd ed. By E. B. Shand, Mc-Graw-Hill. \$10.

METALLURGICAL THERMOCHEMISTRY. By O. Kubaschewski and E. LL. Evans. Pergamon Press. \$10.

# REDUCE YOUR REFUSE DISPOSAL COSTS

With These Low-Investment Systems



THE DEMPSTER-DUMPSTER



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The big savings in refuse disposal are made with mechanized, containerized, collection equipment. Dempster Brothers, the pioneer manufacturer of containerization equipment, now offers four efficient systems to help you increase your efficiency and decrease costs.

The DEMPSTER-DUMPSTER handles containers up to 15 cu. yds. The DEMPSTER-DUMPMASTER, available in three sizes, picks up and empties containers from one through

six cu. yd. capacity. Compaction bodies are 18, 24 and 30 cubic yards with capacities up to 120 cubic yards of loose refuse. The DEMPSTER Compaction Trailer will hold and haul over 200 cubic yards of loose material per trip and it can be loaded by the DEMPSTER-DUMPSTER GRD-304-F-2. The DEMPSTER-DINOSAUR offers giant containers up to 40 cu. yds. and over. Write today for complete information.

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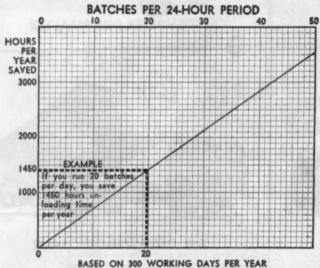


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# LETTERS:

#### **Just Plain Engineers**

Sir:

The last several paragraphs of your report on the AIChE Golden Jubilee meeting (Aug. 11, pp. 155-156) remind me of a more sensitive period in my life.

At a pre-depression convention at an elite mid-southern resort, a dowager, observing the large number of men at the dinner hour, inquired, "Who are all these men?" When informed they were engineers, she declaimed, "Next we can expect plumbers!"

So long as the motorman, crane operator and boiler fireman—all respected trades—are called "engineers," so long will the qualifying adjective (chemical, mechanical, etc.) need to be used to assure our neighbors of our correct status. The optimism expressed in your article about the eventual results of more steps toward engineering unity is admirable, but with the present lay interpretation of "engineer" it could be overly visionary.

Since the dictionary also includes us with the tradesmen mentioned above, perhaps a change in name would help. How about the word "scienceer"?

G. M. BARROW

Westinghouse Electric Corp. Newark, N. J.

#### **Kudos From EJC**

Sir

I've just finished reading the article, "Does Your Employer Own Your Knowledge?" appearing in your July 28 issue (pp. 127-130).

I have been interested in the Miller and Spevack cases for some months now from the point of view of the Engineers Joint Council. I am aware of the complexity of these theses and of the great skill required to carve out the professional questions involved.

Your article does it in an excellent fashion and serves the great purpose of conveying an enormous amount of information

# PRO & CON

C. H. CHILTON

and the professional heart of the problem to many interested people.

W. T. CAVANAUGH Engineers Joint Council New York, N. Y.

#### Too Many Ch. E.'s?

Sir.

I read with interest Mr. Vasey's letter in your July 14 issue (p. 182). Perhaps Mr. Vasey is correct. I believe my experience justifies his views.

I am a graduate chemical engineer, but with absolutely no experience as a chemical engineer. Sorry, but we don't use chemical engineers in the Northwest; mechanical engineers, yes.

So I work as a mechanical engineer in a shipyard. I find that I have just as much fun on the beach as the next guy, and the money that is paid me spends just as fast as the money paid a chemical engineer.

About the only thing a degree will do is to open the door for an interview. The rest is up to the individual.

I say encourage our young people to study for an engineering degree regardless of special field. This will teach them to think, if nothing else. It will give them the tools to earn a living, and in the final analysis, that is what a college education is for.

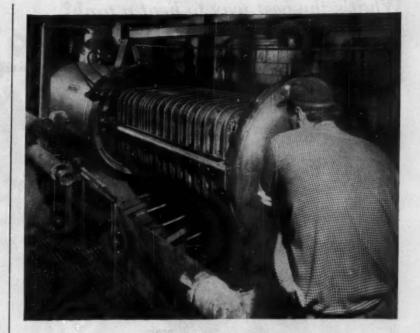
DAVID N. ALLEN Bremerton, Wash.

### More on Rotating Furnaces

Sir:

I was pleased to see the news items about rotating furnaces in some of your recent issues. These stories should arouse more interest in this type furnace.

In your July 28 issue (p. 56), you refer to Elektrokemisk as "licensing agent for the basic Ellefsen patent." Your readers might be led to believe that production of phosphorus in a rotating furnace would infringe that patent. The Ellefsen patent was the subject of an infringe-



# More time on stream!

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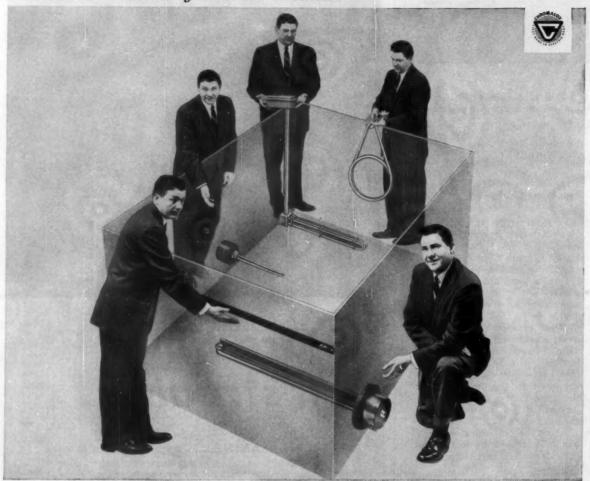
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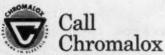
- In the foreground, CHROMALOX Strip Heaters are clamped to the tank wall, heating by conduction, without contacting the tank contents. Tank interiors have full work space—cleaning is simplified.
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PRO & CON . . .

ment suit in Federal court, and a decision was rendered to the effect that the production of elemental phosphorus in a rotating furnace "does not infringe any of the claims of the Ellefsen Patent 2,300,355."

TVA has obtained an equipment patent (U. S. 2,744,944), which covers the design of its rotating phosphorus furnace. This patent has been licensed to one company and is available for licensing to other companies on a royalty-free basis.

We would not like to see adoption of the rotating phosphorus furnace by industry delayed because of an uncertainty about the patent situation.

M. M. STRIPLIN, JR. Tennessee Valley Authority Wilson Dam, Ala,

#### More on Continuous TiO2

Sir:

I read with interest your Chementator story (Aug. 25, p. 53) about work in Australia on continuous digestion of ilmenite.

National Titanium Pigments Ltd. of Luton, Bedfordshire, England, was operating a continuous digestion of 20-30 tons of ilmenite per day when I first joined that company as a research chemist in 1939. They continued to do so until I left in 1947; as far as I know they are still operating the same process today.

Ilmenite, ground to 60% through 300 mesh, was slurried with 20% oleum. The slurry was mixed continuously with water in a digester which consisted of an iron trough about 6 ft. dia. and 15 ft. long, having two sets of meshing spiked shafts. The shafts were driven with a 30-hp. motor. The spikes were tipped with tool steel to reduce wear.

No heat was required to maintain the reaction. The trough was manually filled at the beginning of a run by a batch digestion carried out in a separate pot. At the end of two weeks to one month of continuous operation, the digester was shut down for maintenance work and an alternate digester started up.

Steam generated, along with some SO<sub>2</sub>, was taken through the roof via wooden ducts. The solid

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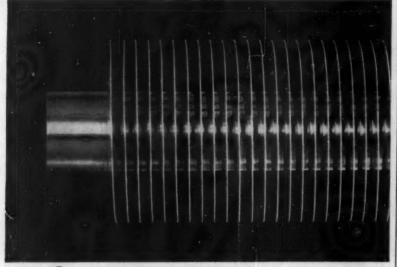
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overflowing from the end of the digester was mixed with weak return liquor and scrap iron in a series of three lead-lined leaching vessels. The resulting liquor was passed to a settling tank, from which the coarse solids passed to a series of countercurrent thickeners and the overflow liquor passed to clarification.

Scdium sulfide was added to the clarifiers to precipitate antimony sulfide, which carried down the fine solids. (A little antimony oxide had been added to the initial charge.) The underflow passed to the thickeners, while the clear overflow was cooled to crystallize FeSO., evaporated under vacuum from about 200 g./l. TiO, to 240 g./l., clarified on sand filters and passed to hydrolysis. The weak liquor from the washers was returned to the leaching circuit.

The point of this letter is to indicate that the work has been successfully operated on a commercial scale for several years.

A. A. MAYLING Consolidated Denison Mines Ltd. Spragge, Ont.

#### Bare vs. Installed Costs

Sir:

Your classic article, "Cost Data Correlated" (June 1949, pp. 97-106), has one annoying feature. This is the fact that you used installed costs, rather than bare or delivered costs.

Now, in a recent appearance of your CE Cost File (Sept. 8, pp. 141-142), we are back to installed costs again. This means that I have to caution a dozen or so people here to read the fine print.

For example, take a steel storage tank. If we are not going to insulate it, and if it is going to be up on the third deck of a structure, the cost curves immediately have to be adjusted somehow. Besides, our overhead and design costs are probably different from those used by Mr. Gushin of General Aniline.

Also, I have two or three cost figures for Type 304 stainless tanks which I want to check against Gushin's curve. I know the delivered costs, but our property records of installed costs probably don't reflect the same installation figures as do General Aniline's.

Published costs of equipment would therefore be of much more value to everyone if they reflected delivered costs only.

I also think that publishing the ENR and Marshall & Stevens indexes along with the date on each graph would be helpful to cost engineers.

NORMAN G. BACH

Monsanto Chemical Co. Texas City, Tex.

Description to the desired the state of the costs are more useful to them than bare or delivered costs. Which basis do you prefer for published cost data? Your opinions would help us in resolving this question,—ED.

#### Pro: Pure Language

Sir:

In your Aug. 25 issue (p. 53), you use the word (?) "continuize" in describing a new Australian TiO<sub>2</sub> process. My dictionary shows no such word.

Even while one admits that English is a living language and that none but the most fanatic purist will argue for no changes in it, one has to draw the line somewhere. It would seem that the line ought to be drawn prior to the point of indiscriminately promoting adjectives to verbs by adding the ending "-ize."

The use of "governmentese" such as this may also create a problem in semantics. For example, think of how your foreign reader, who has not yet the English language good, will have to struggle with this word.

Please, let us optimize our use of the language before we finalize it; and above all, leave us not bastardize it.

R. A. EWING

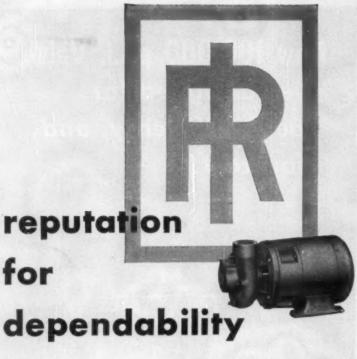
Columbus, Ohio

► Mr. Ewing is absolutely correct in one respect: the word "continuize" does not appear in the dictionary.

However, the dictionary does recognize the suffix "-ize" as the verb form meaning to render or make liks. We believe that even our foreign readers can comprehend the intended meaning of "continuize" from its root word and suffix.

We assume that Mr. Ewing himself justifies his use of the word "finalize" on the same basis, since this is not a dictionary word either. —ED.

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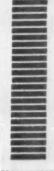
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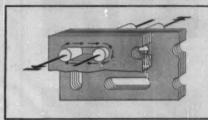


Fig. 1. The two conductors passing through the same window of the iron laminations comprise a 1 to 1 ratio transformer. The currents in the conductors must be equal except for the magnetization current, which does not exceed a maximum of  $\pm\,10\%$  of cell current.

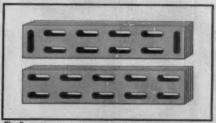


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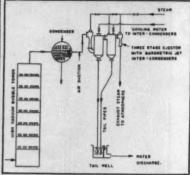
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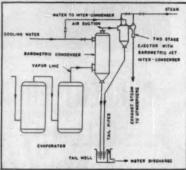
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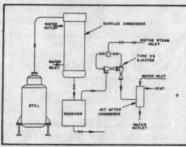
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High Capacity-Low Loss

For quick delivery and engineering know-how in controlling gas and air flow—

Call Norwalk



#### INDUSTRY'S COMPLETE LINE

Check Valves Pipe Sizes 36" to 42" Screwed and Models to 4". Manometers Pressure or Vacuum. Pressure Controllers Pressures to 5 psi. Appliance Regulators Pipe Sizes 1/2" to tation Regulators Pipe Sizes 3" to 24". iquid Seal or Diaphragm Types. lellef Valves Pipe Sizes V2" to 24". illers Pipe Sizes V2" and up.

Complete Engineering Cooperation

# NORWALK VALVE CO.

SOUTH NORWALK, CONN.

Philadelphia + Pittsburgh San Francisco . Washington, D.C.

In Canada: Onter Ltd., Terente . Bescom Corp., Ltd.,

# LOOK WHAT HAPPENS

Call Cambridge

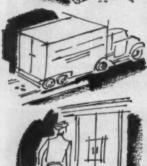
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# **Bulk or Fabricated Parts**



#### INQUIRIES ARE ANSWERED PROMPTLY-

Whenever you call or write for information on prices, availabilities or service, you get a prompt reply.



#### DELIVERIES ARE MADE ON TIME-

Orders for the most frequently used types of wire cloth are promptly filled. If we can't supply what you want from our complete stock, we'll schedule our looms to get it to you as soon as possible.

INSTALLATIONS ARE CHECKED-At Cambridge, orders aren't filled and forgotten. Our own sales engineers follow up your order to make sure our product is giving you the best possible

QUALITY, OF COURSE-Individual loom operation and countless checks on mesh size and mesh count assure you of highest quality wire cloth when you specify Cambridge.

Let us quote on your bulk or fabricated wire cloth needs. Samples for Inspection or test purposes are available upon request. Call your Cambridge FIELD ENGINEER. He's listed in the phone book under "Wire Cloth." Or, write direct for FREE 94-PAGE CATALOG and stock list giving full range of wire cloth available. Describes fabrication facilities and gives useful metallurgical data.



#### The Cambridge Wire Cloth Co.

Department G, Cambridge 10, Maryland



LITERATURE . . .

Gear, planetary.....for high speeds
...high horsepower. Small size,
light weight; wide application; convenient arrangement. Bulletin 2400
gives other features.
97 \*DeLaval Steam Turbine Co.

Light Switch.....A new photoswitch light control gives automatic on-off control for any lighting system that should be keyed to outdoor light conditions.

226A Electronics Corp. of Amer.

Motors, Tube Ventilated.....For big fans, blowers, pump drives...heavy duty applications where you need large motors with highly effective cooling systems. 126 \*Wagner Electric Corp.

Rectifiers, Silicon.....approximately 95% overall efficiency for low & medium voltage applications. Drawout construction makes replacement quick & easy. Information.

12-13 \*Westinghouse Electric Corp.

Scales.....Electronic control & instru-mentation permits remote location of weight recording instruments ... assures automatic balance detection, etc. New Literature. 102 \*Fairbanks-Morse

Speed Reducers....Book 2618 contains engineering and selection information on several types and sizes of shaft-mounted speed reducers. Mount angular or horizontal.

226B Link-Belt Co.

Spiralectrodes......installed in "SF" electric precipitators deliver more electron emission. Detailed information of this & other features in booklet which is offered.

198 \*Buell Engineering Co., Inc.

Starters, high voltage.....new air-break contactor with solenoid design wreak contactor with solenoid design & only one moving part. Available in full voltage & reduced voltage starters. Publ. 6080. 25 "Allen-Bradley Co.

Turbine, Gas.....The 1000 KW com-bustion gas turbine design empha-sizes simplicity, ruggedness & favor-able specific fuel consumption. Minimum handling equip. is required. \*Gas Dynamics Inc.

Turbine, Vertical.....has an almost indestructible rotor. It is available in capacities from 5 to 300 HP. Bul-letin S-137 gives complete information. 107 \*The Terry Steam Turbine Co.

Wire, Thermocouple....is designed for problems of high temperature, moisture, abrasion, pressure, chemical or corrosive action, & difficult installation. Cat. 31-300-E.

220 \*Thermo Electric Co., Inc.

#### Handling & Packaging

Bulk Handling System.....The Tote, mechanical, automatic system, is based on metal bins plus filling & discharging equipment. Catalog contains details.

44

\*Tote System. Inc. \*Tote System, Inc.

Containers, Steel....Perma-Lined containers for hard-to-hold chemical products. Perma-Lining enamels are airless hot sprayed after fabrication for interior coverage.

190 \*Continental Can Co.

\* From advertisement, this issue

- Conveyor.....A totally enclosed pulkmaterial handling conveyor features a two-direction chain to convey in any direction. Photographs and layouts.

  227A Prab Conveyors, Inc.
- Conveyors.....Method of constructing belt conveyor systems with steel rope instead of rigid framing is described in a new specification sheet. 227B Joy Mfg. Co.
- Drum.....Aqueous HF in a new, safer "drum-within-a-drum" which combines the advantages of polyethylene & steel. Drum requires no venting and cannot corrode or leak. Information offered.

\*Allied Chem., General Chem. Div.

- Drums, Steel....Rust-inhibited drums and stainless steel containers to meet all requirements & specifications are outlined in a brochure that is offered.

  179 \*U. S. Steel Products Div.
- Drum Vent.....No. 5522 Drum Fitting is a fire & explosion-safe, pressure-vacuum relief vent for installation in 2" end bung opening of drums stored in horizontal position.

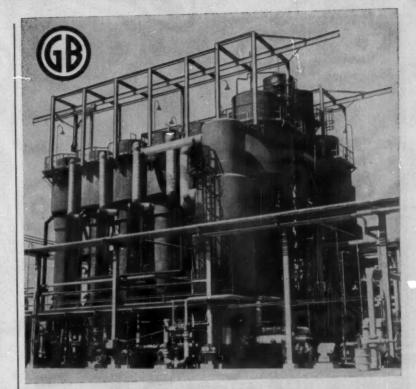
  177a \*The Protectoseal Company
- Idler.....Bulletin 925 tells the story of the Permaseal Idler, detailing development and outstanding features. Drawings, photos and detailed exposition. 227c Jeffrey Mfg. Co.
- Industrial Truck.....Four-page folder describes the Model F-45T4, 4,000lb. capacity, electric-powered industrial truck. Complete dimensional and design data. 227D Elwell-Parker Electric Co.
- Materials Handling.....Complete data on the new model H-25 Payloader available. Handles more material per hour at less cost per ton. Carry capacity of 2,500 lbs. 8 "The Frank G. Hough Co.
- Safety Vent....Booklet entitled, "Storage Tank Safety Vent Fundamentals" is available immediately. Gives complete data on Flammables Engineering.

  177e \*The Protectoseal Company
- Scales, Bagging . . . Information available on different models of automatic bagging equipment & scales. Accessories include automatic feeders, sewing conveyors, etc.

  206 \*Richardson Scale Company
- Storage Cabinet.....The Flammable
  Liquids Safety Storage Cabinet is
  designed to meet the specifications
  of the N.F.P.A. Details for on-thejob storing available.
  177b \*The Protectoseal Company
- Tanks, Process.....Bulletins 5-2 & C-1 contain complete information on tanks with mild steel or concrete shell, corrosion-proof linings & acid brick sheathings.

  R232 \*Atlas Mineral Products Co.
- Tractor Automatic.....Bulletin 586 presents information on the Guide-O-Matic, the electronic industrial tractor that requires no operator. 227E Barrett-Cravens Co.
- Weighing System.....The new Bul. 582 describes in detail the Way-Pac line of low-capacity, low-price packaged systems for tank weighing & figuring costs.

  41 \*A. H. Emery Co.



## Reynolds Metals Expands with G-B Alumina Liquor Evaporators

Shown here are the original G-B self-supporting, sextuple effect alumina liquor evaporators in use at the Reynolds Metals plant in Corpus Christi, Texas. The fifth and sixth units, offering still greater steam economy with a minimum of fouling will go into use alongside the original units this fall. This is typical customer-confidence in G-B designed evaporators. From planning board to installation it will pay you to see G-B first!

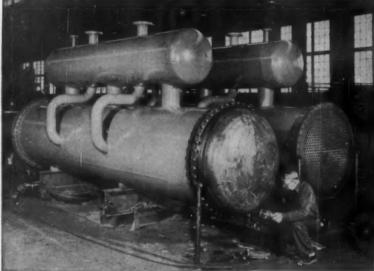


#### GOSLIN-BIRMINGHAM MANUFACTURING CO., INC. BIRMINGHAM, ALABAMA

FILTERS • EVAPORATORS PROCESS EQUIPMENT CONTRACT MANUFACTURING including HEAVY CASTINGS

4

<sup>•</sup> From advertisement, this issue



Shown are two Vilter 48" diameter x 18" long ethylene giycol chillers built to A.S.M.E. standards

# VILTER

# can meet your HEAT EXCHANGER NEEDS

The above two 48" diameter x 18' long ethylene glycol chillers are typical of the custom work Vilter is doing in the field of heat exchangers and pressure vessels to meet exactly design specifications and budget requirements.

Vilter has successfully resolved many problems of cooling under intense pressures, and has designed and produced hundreds of heat exchangers, pressure vessels, and high pressure synthesis condensers to exacting specification for many types of chemical and petroleum applications. Vilter vessels are built in conformance to A.S.M.E. or T.E.M.A. standards.

Vilter makes all four basic types of heat exchangers: shell and coil, shell and tube, shell and tube bundle, and atmospheric...and in every possible modification. Vilter can give you the most efficient heat exchange equipment and pressure vessels with working pressures as high as 10,000 psi.

The Vilter facilities include automatic welding, X-ray and Zyglo-Pentrex inspection.

Today, more than ever before, the leading names in both the chemical and petroleum industries are turning to Vilter for their special vessel needs. Consult with Vilter about your needs.

Write for these helpful bulletins to The Vilter Manufacturing Company, Dept. K-709, 2217 S. First Street, Milwaukee 7, Wisconsin.







Bulletin 707 Vilter Condensers Brine Coolers Heat Exchangers

Bulletin 827 Vilter Industria Heat Exchange

REFRIGERATION and AIR CONDITIONING

THE VILTER MANUFACTURING COMPANY, Milwaukee 7, Wisconsin

Air Units ... Ammonia & Frech Compressers ... Boaster Compressers ... Baudelet Coolers ... Water & Brine Coolers ... Blast Freezers ... Evaporative & Shell & Tube Condensers ... Pipe Coils ... Valves & Fittings ... Pakics & Polaritake Ice Machines

#### **Heating & Cooling**

- Coils Cooling.....Bulletin 880 contains complete coil selection information as well as detailed descriptive information on the coils themselves. 228A American Air Filter Co.
- Coils, Smooth-Fin.....offer greater heat transfer & lower airway resistance. Tapered fin design provides efficient heat transfer surface. Bul. S-55.
- Cooler.....Aero after cooler removes moisture from compressed air. A self-contained system, solving the problems of water supply & disposal. Bul. 130. TL235 \*Niagara Blower Company
- Feedwater Heater Standards.....Second edition of publication contains new material relating to the design, construction and installation of feedwater heaters. 228B Feedwater Heater Mfgs. Assn.
- Heat Exchangers.....Bulletin 707 outlines Vilter Condensers, Brine Coolers & Heat Exchangers. Bulletin 827 gives information on Vilter Industrial Heat Exchangers. 228 \*The Vilter Mfg. Co.
- Heat Exchangers.....Readily assembled to handle any combination of liquids & gases. Can be used as a heater, cooler, condenser or vaporizer. Bulletin 302.5K1.

  121 \*American Standard
- Heat Transfer Equipment....Platecoll units are available in a variety of metals & finishes. Features lower space requirements. Bul. P-61 for complete information.

  50 \*Tranter Mfg., Platecoll Div.
- Heaters . . . . . 1958 heaters and devices catalog supplies answers for heating problems involving pipe heaters, immersion heaters, tubular heaters, etc. 228c General Electric Co.
- Heating Equipment.....The complete story on Grid unit heaters, blast heats, & Grid radiation for chemical use are contained in catalog No. 956.

  \*D. J. Murray Mfg. Co.
- Kiln, rotary.....Bulletin 1115 gives whole story of Traylor leadership and experience in rotary kiln design and manufacture. Features oil reservoir and oiling mechanism.

  134 \*Traylor Engrg. & Mfg.
- Liquid Heat Systems.....Pertinent information on high-temperature liquid heating and cooling systems using tetra aryl silicate medium covered by new bulletin.

  228D American Hydrotherm Corp.
- Refrigerating Equipment......for the preservation of foods & beverages during process & in storage. Used in Petroleum refineries, chemical plants, etc. Bulletins offered.

  173 \*Henry Vogt Machine Co.
- Steam Trap.....Gets equipment hot fast & keeps it hot. A complete line for every requirement. Bulletin "The Why and How of Steam Trapping" is offered.

  29 \*Yarnall-Waring Co.

<sup>\*</sup> From advertisement, this issue

#### Instruments & Controls

Analyzer, Gas.....Continuous analysis of one component in multi-component gas mixtures. A new bulletin on this inexpensive thermal conductivity analyzer is offered.

113 \*Mine Safety Appliances Co.

Computers, Electronic......LGP-30 is easy to operate, plugs into any regular wall outlet and is completely mobile. Detailed information & specifications offered. 205 "Royal McBee Corp.

Flow Switch....Devices which respond to flow of liquid in a pipeline to make or break an electrical circuit are discussed in new bulletin. 229A McDonnell & Miller, Inc.

Gage, Multi-Pointer....Features, compact size, choice of colors, fluorescent illumination, colored scales, unlimited indications, etc. Additional information available.

104 \*Bailey Meter Company

Goniometer, Optical....identifies crystalline substances by simple external measurements of inter-facial angles. Claimed accurate, easy to operate.
53-540
\*U. S. Industrial Chemicals Co.

Graphic Recorder......Model 1100E
Variplotter features dual selection
of input sensitivity. Specifications
and closeup photos of control surfaces. Bul. AP-810.
229B Electronic Associates, Inc.

Instrumentation. ... Electronic Conso rumentation....Electronic Conso-trol is 2 counterpart of its world-famous pneumatic Consotrol line. For the full story on this process control, Bul. 21-10. The Foxboro Co.

Instruments......A 20-page brochure on Rotating Viscosimeters, Fiber Tester, Hardening Time Meter, Bi-axial Alternate-Stress Testing Ma-chine, Vulcameter, etc. 192 \*Brinkmann Instruments, Inc.

Liquid-Level Controls.....Bulletin PF 571 contains detailed specs, complete descriptive data, charts and dimensions for a complete line of liquid-level controls.

229C Electronics Corp.

Meter, Stainless Steel.....is available with Direct Reading, Print-O-Meter or Auto-Switch Registers. Size 1½", capacity 100 gpm. with most liquids. Bulletin 94/10 H. 196 "Neptune Meter Co.

Pyrometer....Type 1500 portable pyrometer is available in ten scale ranges from 0-400 to 0-3000 F. or centigrade equivalents. Full details in Bul. 4434.

L233 \*Illinois Testing Laboratories

Radioisotope Lights.....Light sources for industrial signal systems and markers now come in models that are radioisotope-excited. Kryptongas is used. U. S. Radium Corp.

Viscometers......Viscosity can represent a fundamental property which will determine a fluid's ultimate composition or quality in use. Information on instruments offered.

R249 \*Brookfield Engineering Lab.





Using vertical polarized light on a cross-section of pipe, photographer Bernard

# Controlling Corrosion in Fluid Engineering

Corrosion seldom works alone. Together with heat, pressure and abrasion factors, it compounds the problems of fluid engineering. But when you have valve design problems involving corrosion, you can look to the engineering leadership available at S. Morgan Smith for assistance.

You can use R-S Rubber-lined Butterfly Valves, for instance, to handle many special applications. The rubber lining protects the entire valve body, gives you corrosion resistance with maximum economy. Where your processing problem demands additional engineering, you can draw on the broad SMS background of experience in specialized valve applications.

There is a complete SMS line - Rotovalves, R-S Butterfly Valves and Ball Valves - to meet your fluid control problems. To obtain full information, contact our nearest representative, or write S. Morgan Smith Company, York, Penna.





AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

. Ball Valves . R-S Butterfly Valves . Free-Discharge Valves . Liquid Heaters . Pumps . Hydraulic Turbines & Accessories



Consider all the money-saving aspects of a Sperry Filter Press. These include low initial cost . . . nominal installation . . . minimum maintenance . . . low depreciation . . . and an economy of operation

that extends through many years of trouble-free performance. However complex your filtration problems may be, these

economies are basic to the solution.

You can avail your plant to the economies of a Sperry Filter Press, custom-engineered to meet your particular requirements for flow rate, cake build-up, washing, extraction, thickening, etc. Variations are provided, offering center, side or corner feed; open or closed delivery; simple or thorough washing; high or low temperature control. Plates may be had in aluminum, wood, iron, bronze, stainless steel, lead, rubber, nickel or any other special materials to meet your requirements. Any filter media can be used
... cloth, synthetics, wire screen ... paper. Labor-saving plate
shifting devices and semi-automatic closing attachments are adaptable for any model . . . to increase production, minimize operation hazards and reduce wear and tear.

> FOR A LOW-COST ANSWER TO YOUR FILTRATION PROBLEMS, SEE THIS SPERRY CATALOG . . . an up-to-date fully illustrated reference manual of erection, operating, design and construction data and specifications. Mail coupon for your free copy today.

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#### Pipe, Fittings, Valves

Fittings.....Tees, ells returns reducers, stub ends, caps, crosses and 45 laterals are available in stainless steel, monel, nickel and aluminum.

6 \*Flowline Corp.

Fittings, Stainless Steel......special non-standard fittings furnished to order. Feature sharp clean threads, wide reinforced bands, & uniform wall thickness. Catalogs.

207 \*Camco Fittings, Inc.

Joints, Expansion.....made in a wide variety of stainless & high tempera-ture alloys in a range of sizes from ½" to 35 ft. in diameter. A new pamphlet describes the line. 130 \*Solar Aircraft Co.

Nozzies.....for oil atomizing, air washing, spray ponds, acid chambers, concrete curing and milk powdering. Information on nozzies for all spray problems in Catalog 1.

L237 \*Monarch Mfg. Works, Inc.

Pipe, Centrifugally Cast......can be produced in OD ranging from 2¼ to 2¼ and in lengths up to 15 ft. according to diameter. It is free of gas pockets, blow holes, etc.

222 The Duraloy Co.

Pipe, PVC.....is available in sizes ¼" through 6" in schedules 40, 80, and 120. A new 32-page illustrated cata-log on this pipe is available. 69
"A. M. Byers Co.

Pipe, PVC......Manual gives detailed information for selection and ap-plication of PVC pipe, tubing and fittings. Illustrated with charts, tables and photographs. 230A Carlon Products Corp.

Piping, Alloy.....New bulletin covers mechanical and physical properties, sizes, finishes, composition of special purpose alloys for tubing and pipe. 230B Carpenter Steel Co.

Safety Head....provides an instantane-ous, unrestricted opening when pres-sure-relief requirement is greater than discharge capacity of valve. Detailed information. 208 \*Black, Sivalls & Bryson, Inc.

Seal, Shaft.....for every service ...
from hot or cold water to acids &
corrosives ... high temperatures,
high pressures. Bulletin S-204-3 for
complete overall information.
202 \*Crane Packing Co.

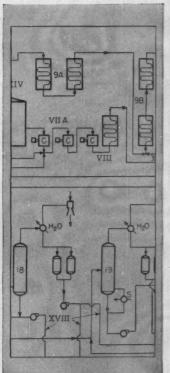
Tube Cleaners.....Various types to do all jobs quickly and effectively. Write today for details on tube cleaning and maintenance equipment for your needs. \*Elliott Co.

Tubes, Condenser.....The new edition of Publication B-2 gives complete information and technical assistance in the selection of the alloy to give the best service.

26 \*The American Brass Co.

oing.....Condenser tube in a wide range of sizes & alloys. Truffin type S/T is specifically engineered for use in shell & tube heat exchangers & condensers. 33-36 \*Calumet & Hecla, Inc.

<sup>\*</sup> From advertisement, this issue



# Large chemical process equipment

designed and built by Dravo's experienced team of engineers and production men, can often mean large dollar savings to your company. Dravo's know-how in custom-built equipment can help you reduce costs through use of large, efficient processing units.

Find out how this service can add dividends to your processing equipment investment. Contact Process Equipment Department, Dravo Corporation, Pittsburgh 25, Pa.



A flexible compact unit that combines a powerful disperser head with a rugged diamond-shaped agitator to produce finished homogeneous batches without further processing—for most chemicals, inks, plastics, pharmaceuticals, cosmetics, paints, and industrial finishes.

Modern design gives high degree of shear, kinetic impingement, and complete mulling action for better wetting, improved dispersion, and uniform blending. Small size laboratory models available.

SEND SAMPLES OF YOUR MATERIALS FOR TRIAL PROCESSING. No obligation. Write TODAY for new 1958 TROY Processing Equipment Catalog, fully describing the Troy Line of Angular Mixers, Colloid Mills, Roller Mills and Unit

ENGINE & MACHINE CO.
Pennsylvania Tel: Troy 32

# SOLVENT RECOVERY CUTS

**SAVE 65% TO 80% ON** PROCESS SOLVENT COSTS

Solvent recovery by the COLUMBIA Activated Carbon system can cut manufacturing costs in any operation where low-boiling organic solvent vapors can be collected. For instance . .

- · Acetate fiber manufacture
- Coating operations
- · Rotogravure printing
- Plastics processing
- Rubber products manufacture
- Pharmaceutical production
- Dry cleaning
- Metal degreasing operations
- Solvent extraction
- Manufacture of smokeless powder

Solvent recovery is the efficient, economical way to recover solvents vaporized in manufacturing processes. What solvents can be recovered? Well, alcohols, esters, ethers, ketones, hydrocarbons, chlorinated compounds, and practically all mixtures of these solvents can be recovered and reused. And look at these facts . . . recovery plant efficiency-more than 99%: cost of recovery-1 to 2¢ per pound.

This means that the initial cost of solvents becomes a secondary consideration because they can be used over and over again. Fire and health hazards are reduced, too!

CARBIDE can tell you how a solvent recovery plant can efficiently and economically recover your process solvents. Write now for the booklet, "Solvent Recovery by the COLUMBIA Activated Carbon System." Address Department B, Union Carbide Olefins Company, 30 East 42nd Street, New York 17, New York.



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Catalog A-7 FOR COMPLETE INFORMATION



MAC-IRON BLINDS, SPACER RINGS,

TEMPORARY STRAINERS, LINE STRAINERS, PIVOT FLANGES

This comprehensive booklet is your guide to the use of specialized equipment planned and produced to function with extreme efficiency. Detailed specifications, descriptions, and data are included.

In the years of supplying to the Petro-Chemical Field MAC-IRON has developed a design and pro-duction service to a degree seldom equalled. If confronted with an emergency or tight schedule, PHONE US. If not in stock, the equipment you need will be made up at once.



Your inquiry will promptly bring a copy of Catalog A-7 or spe-cific engineering data. PHONE MAIN 6-3712 FOR IMMEDIATE PRODUCTION OR ONSULTATION SERVICE

"IF YOU USE PUMPS You need MAC-IRON Strainers"



LITERATURE . . .

Valves.....Continental Butterfly type can be made to your specifications, of any metal, to withstand any temperature or pressure desired. Sizes range from 2" to 36". 167 °Fisher Governor Co.

ve.....Bulletin 4072-C gives com-plete information on a new valve designed for use in all 100,000 p.s.i. systems. It is corrosion resistant & light in weight. 215 \*American Instrument Co., Inc.

Valva.....completely removes all dust & scale. Available in cast iron for pipe sizes from ½" to 4" & in fabri-cated steel in larger sizes. Pressures to 125 psi. R225 Norwalk Valve Co.

Valves......Complete information is available on Rotovalves, R-S But-terfly and Ball valves. They han-dle many special applications & resist corrosion. °S. Morgan Smith

Valves..... "Full Flow" bronze valves, available in a new full line. They can be throttled to permit only the minutest amount of fluid through. Illustrated Literature.

75 \*The Wm. Powell Co.

ves......New 600-lb. forged steel valves are available with either high-flow ports (1300 line), or standard-flow ports (1100 line). Specification literatured. 123 \*The Ohio Injector Co. Valves

Valves, Acid Proof. . . . Many types available in Tufclad chemical porcelain in 1/2" to 6" sizes. Description & specifications on the entire line is available. \*Lapp Insulator Co., Inc.

Valves, Ball....The new "316" gives positive sealing over a wide range of pressures. Complete line of Ball Valves are described in a new cata-\*Rockwood Sprinkler Co.

Valves, Cast Steel......available in alloys that meet a wide variety of specifications. Also, a wide choice of patterns, sizes & seating material combinations. Catalog. 91 "Jenkins Bros.

Valves, Diaphragm.....A new booklet discusses primary considerations in selecting valves, shows engineering principles & benefits of diaphragm valve & applications. 40 Hills-McCanna Co.

Valves, Plug.....sealed by tough, film of pressurized lubricant & seats are never exposed to the line. A com-plete line of accessories are avail-\*Rockwell Mfg. Co. 117-118

Valve, Spray.....Solenoid valves control pressure surges in nuclear reactions. ASCo now offers a family of valves designed for atomic energy applications. Cat. #202. applications. Cat. #202. 77 \*Automatic Switch Co.

#### **Process Equipment**

Burner, Vortex.....Here is a versatile unit that gives rapid, clean combustion on a wide range of fuels. Standard models available . . . instant ignition. Bulletin #111: 194

Thermal Research & Engineering \* From advertisement, this issue

# Atlas

#### PROCESS TANKS COST LESS LAST LONGER



#### ... compared to expensive alloys!

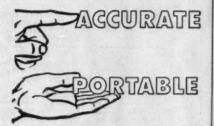
Atlas offers you economical process tank construction that will give you longer trouble-free life. This is accomplished by the use of a mild steel or concrete shell protected by corrosion-proof linings and acid brick sheathing jointed with corrosion-proof cements. These Atlas tanks are impervious to today's stronger chemical solutions and higher operating temperatures.

All metals have a real solution rate that may contribute to contamination of the product but Atlas tanks offer complete protection against this possibility. In addition, Atlas construction is far less costly to install than expensive alloys and the tanks are corrosion-proof inside and out. Write for Atlas Bulletins 5-2 and

C-1.



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# alnor PYROMETER

**TYPE 1500** 

Checking temperatures of electric heating mantles is but one of the many laboratory temperature jobs performed with consistent accuracy within ¾ of 1% full scale-under all conditions.

Sturdy, protective case eliminates need of careful handling of precision meter movement in portable use. Direct reading scale face can be quickly read at distance-no slide wires or conversion tables needed. Available in ten scale ranges from 0-400° to 0-3000° F. or centigrade equivalents.

Get full details on the Type 1500 Portable Pyrometer in Bulletin 4434. Attach this ad to your letterhead and mail to: Illinois Testing Laboratories, Inc., Room 559, 420 N. LaSalle St., Chicago 10, Ill.



PRECISION INSTRUMENTS FOR EVERY INDUSTRY

LITERATURE . . .

Centrifugals......A catalog is offered on the time-saving Batch-Master centrifugal. Rapid bottom dis-charge & hydraulic unloading save processing cycle time. 210 \*Amer. Machine & Metals, Inc.

Cooling Towers....available in special corrosion-resistant stainless steel alloys. Suitable for indoor or out-door installation. Complete indoor installation. formation available. \*Marlo Coil Co.

Crushing & Grinding.....Sturtevant laboratory machines can expose all crushing or grinding parts for thorough cleanouts in a matter of seconds. Ask for Bul. 067.

L224 \*Sturtevant Mill Co.

Desuperheater......The SK Venturi type is designed to reduce the temperature of super-heated steam to the lower temperatures for use in process operations. Bul. 6D. 111 \*Schutte & Koerting Co.

ers, Gas......Units dry to lower dewpoints to give your processes & instruments highest possible pro-tection. For detailed information on your dryer needs, Bul. D-100. 85 The C. M. Kemp Mfg. Co. Dryers, Gas.

Drying, Spray......Herbicides, fung-icides and fine chemicals that are difficult to handle can be processed for maximum yield, product quality & economy economy.

\*Nichols Engr. & Research Corp.

Evaporators, Flash.....For helpful suggestions that will solve your fresh water problems, send for information. A complete line of evaporators for your need.

22

\*Cleaver-Brooks Co.

Feeders, Chemical.....Thirty-six page catalog of valuable information designed to help you select the correct proportioning pump. Gives detailed engineering data.

204 \*Manzel\*

Filter Equipment.....Catalog 58 tells of manufacturer's line of filter equipment—filter sheets, pumps, mixers, etc. Application charts and product specifications.

233A Ertel Engineering Corp.

Filter Media, Metal.....can withstand temperatures from 420° to 1200° F. & pressures from a nearly perfect vacuum to 6,000 psi. Brochures out-line what they can do. 124 °Purolator Products, Inc.

Filters, Metallic.....offer corrosion re-sistance for fuels & other com-pounds such as hydrogen peroxide, hydrazine, ethylene oxide & liquid oxygen. 53-54j \*U. S. Industrial Chemicals Co.

Filter, Vacuum.....The range of filter area available is from 30 to 560 sq. ft. It gets every possible drop of the solubles out of the cake with minimum wash liquor.

4 \*Bird Machine Company

Filters, Valveless.....are completely automatic. They use no expensive valves, flow controllers, pumps or hydraulic or pneumatic control systems. Descriptive bulletin. \*Permutit Co.

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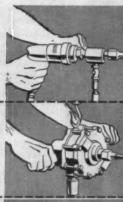
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#### LITERATURE . . .

- Ion Exchange.....for the purification of literally hundreds of chemical products. Details covering an analytical economics study are available. 31 \*Industrial Filter & Pump Mfg.
- Lixator.....The "Sterling Lixator" is a rock-salt dissolver. It automatically controls salt feed, water feed & brine discharge. Other types of Lixators are available. 24a \*International Salt Co.
- Mill, Compacting.....Precise control of particle size, density & solubility factors is assured with compacting process. Bulletin No. 07B8836 gives complete story.

  137

  \*\*Allis-Chalmers\*\*
- Mills, Roller....Designed for quality fine grinding ... 20 mesh to 400 mesh ... micron sizes on some materials. Exclusive gearless & spur gear drives. Facts in catalog. 103 \*Williams Patent Crusher
- Mill, Vertical.....This unit is designed for pulverizing to extreme fineness & uniformity. Automatic & dust free operation. Data on special applications is offered.
  - \*Combustion Engineering, Inc.
- Mixer.....Nauta Mixer gives gentle positive action for uniform dispersion without dusting. Details in Cat. 372. Cat. 381 discusses Customer Service Laboratory. 124 \*\*Blaw-Knox Co.
- Mixers.....Sixty-four pages of comprehensive mechanical design & selection data enable you to make catalog selections of complete paddle or turbine type fluid mixers. 30 \*Philadelphia Gear Corp.
- Mixers.....The turbulizer, a new high speed mixer, produces a homogeneous mix. It is self cleaning & may be furnished in carbon or stainless steel. Color bulletin offered. 89a "The Strong Scott Mfg. Co.
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  BL231

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  234A Hardinge Co., Inc.
- Processing Equipment.....Catalog No. 258 for detailed information on custom fabrication & erection of processing vessels & equipment for industry.

  87 \*Nooter Corp.
- Vibrating Feeders.... Complete descriptions, data and specifications of complete line of electromagnetic vibratory feeders, and other feeders as well, discussed in catalog. 234B Syntron Co.
- Water Conditioning.....The Demineralizer Handbook gives details on demineralization. Find out whether or not it is the answer to your feedwater treatment problem.

  73 \*Cochrane Corp.

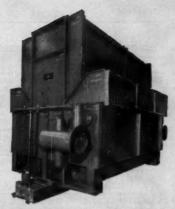
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September, 1958.

[SEAL]

(My Commission expires March 30, 1959)



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Additional "Searchlight" Advertising on pages 240-245

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  perforated basket
  --Baker Perkins type 316 SS Ter Meer Centrifuge, Model HS-24"
  --Sharples \$16P pressurite SS super centrifuge

#### DRYERS.

- 4-Link Belt steel roto louver dryers, Model 207-10, 310-16, 310-20, 604-20
- 504-20
  1—Buflovak double drum dryer, 42" x 120"
  1—Stokes Model 59DS steel rotary vacuum dryer, 5' x 30'
  1—Stokes double drum dryer, 5' x 12'
  1—Louisville rotary steam tube dryer, 8' x 45'
  1—Louisville SS rotary kiln, 30" x 28', complete

#### FILTERS-

- 1-Oliver horizontal filter, 6'6"
- l—Oliver horizontal filter, 6°8"

  1—Feinc SS rotary string filter, 3° x 3' (NEW)

  1—Oliver horizontal 3' pilot plant filter (NEW)

  1—Sweetland #7 filter with 20 steel leaves

  10—Sweetland #1 filters, #12, with 72 SS leaves

  11—Sweetland #3 SS filter

  11—Magara SS filter Model 510-28

  13—White SS 18" 18" 18"

- 1-Shriver SS 18" x 18" plate and frame filter press, 8 chambers

#### **AUTOCLAVES, KETTLES & TANKS:**

- I—Glascote glass lined jacketed kettle, 500 gal.

  I—Lee SS jacketed kettle, 125 gals, 90° W. P.

  I—Theo. Walters 500 SS jacketed reactor

  I—Nickel jacketed 1000 gal. kettle

  I—Patterson steel jacketed 3000 gal. kettle with agitator

- 3—Robinson type 316 SS sigma type jacketed heavy duty mixers, 300 gal. 60 HP.
  3—Howes 40 cu. ft. rubber covered ribbon blenders
  1—Leader 3S jacketed 51 cu. ft. ribbon blender

#### MISCELLANEOUS:

- 2—Heat Transfer Products steel bubble cap column, 36" and 42" with 5 and 10 trays
- Acme steel bubble cap column 42" dia. with 10 trays
- 1—Downington Iron steel bubble cap column, 24" dia. with 14 trays
- 1-Type 316 SS stripping column 8" x 20"
- -Patterson Kelley, Carpenter 20 SS heat exchangers, 500 sq. ft. each
- 2—Patterson Kelley, steel heat exchangers, 1000 sq. ft. each 2—Badger type 316 SS heat exchangers, 400 and 480 sq. ft. 2—Belle & Grossett heat exchangers, steel, 73 sq. ft. each

- Struthers Wells heat exchangers, 885 sq. ft. 1-Patterson Kelley steel heat exchanger, 427 sq. ft
- 50—Steel heat exchangers from 15 sq. ft. to 400 sq. ft. 4—Type 317 SS heat exchangers, 892 sq. ft. each 200 PSI
- 30-Struthers Wells SS heat exchangers 650 sq. ft. each
- 1-Struthers Wells type 316 SS heat exchanger, 330 sq. ft.
- 2—Stokes tablet presses, Model T 1—Bolling 8" x 16" 3 roll laboratory calender
- l-Swenson type 316 SS vacuum crystallizer, 3'6" x 12'
- 1—Swenson type 316 SS vacuum crystallizer, 2'6" x 12'
  - 1-Badger type 316 SS bubble cap column 36" dia, with
  - 1-Badger type 316 SS bubble cap column 42" dia. with 11 travs
  - 1-Acme type 316 SS jacketed kettle, 2000 gal.
  - 1-Pfaudler glass lined jacketed kettle, Series P. 20 gal.

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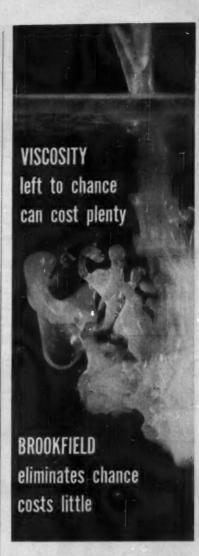
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Citric Acid	(e)	(e)	(e)		
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Ferric Nitro	te				
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Silver Nitr		× (f)	× (f)	(f)	A I
Stress Cracks ×× *×*	-000000××	-000000×	* 0000000×	* 0000000×	×
-Sulfuric Ad	cid, Aerated,	No Velocit	y		
* * * * * * * *		× × × ×	×0× × × 0	00×××××0	\$25555555 \$25555555

Key: Corrosion rate less than 2 m p y

X Corrosion rate greater than 50 m p y

O Corrosion rate less than 20 m p y Corrosion rate from 20 to 50 m p y (f) Acid free

(e) Avoid chlorides

Corrosion data taken from Metals Handbook

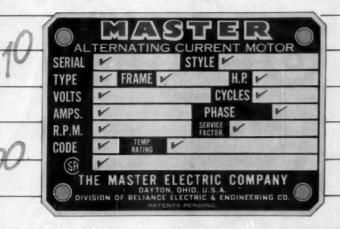
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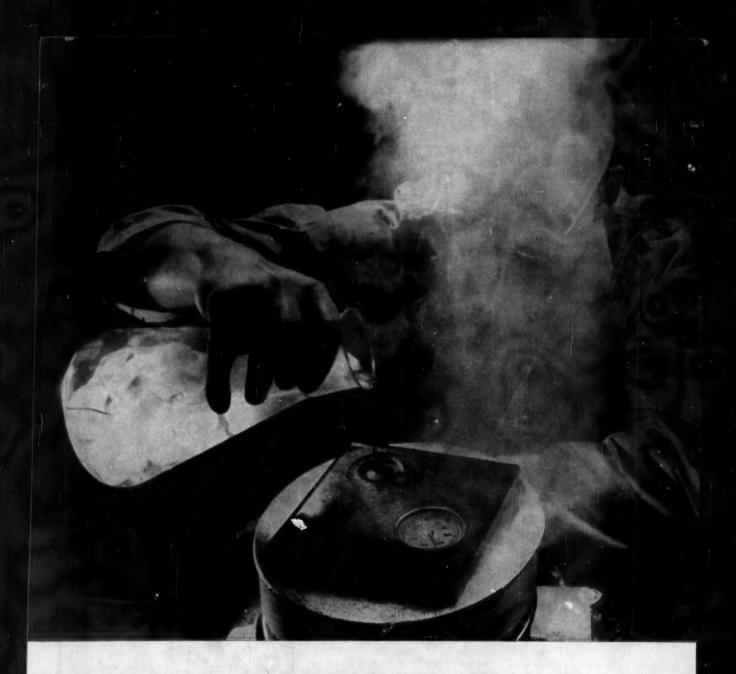
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